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See Page 108

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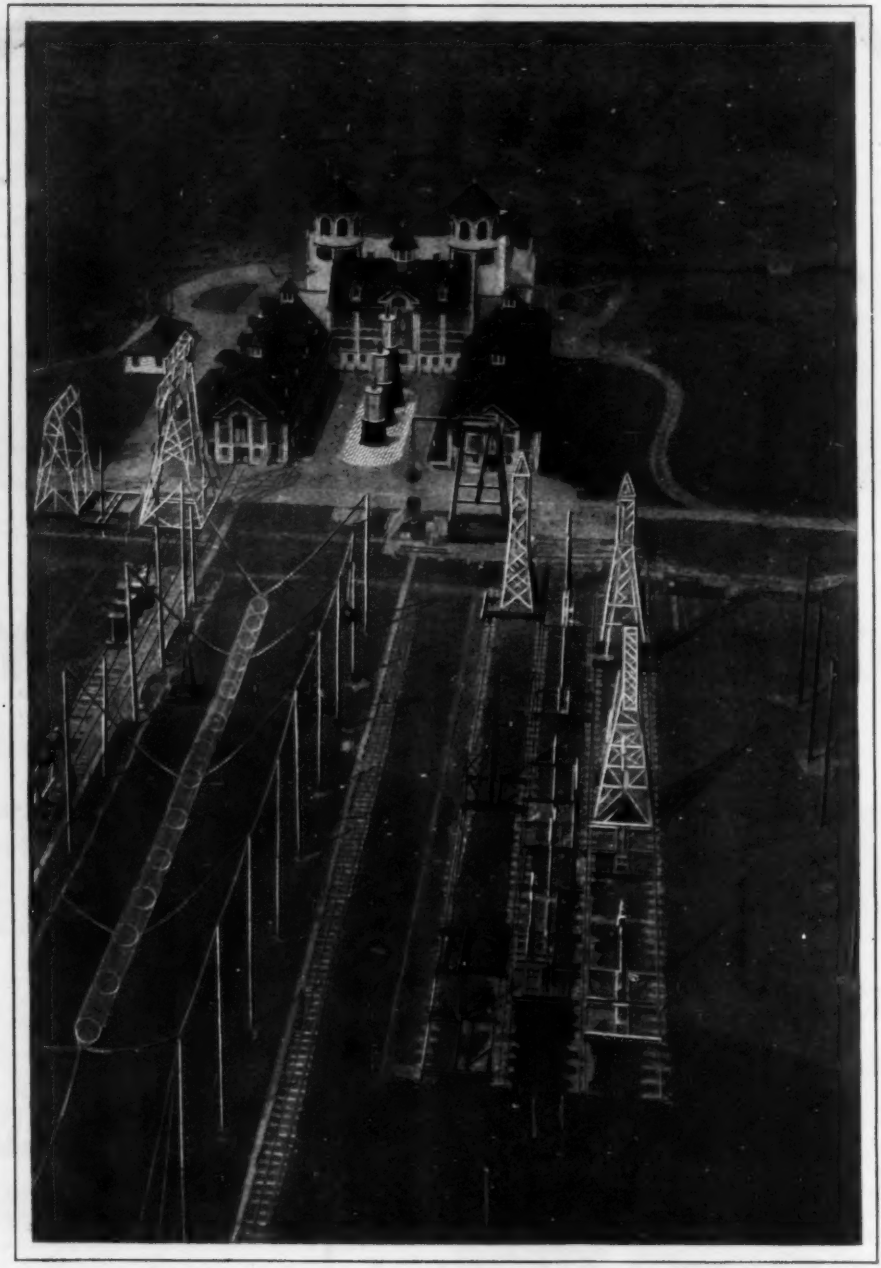

Airplane View of Part of the Outdoor High-Voltage Plant of the Ohio Insulator Company, Where A. O. Austin and Associates Test Aircraft to Determine the Hazards of Flying through Electrical Storms

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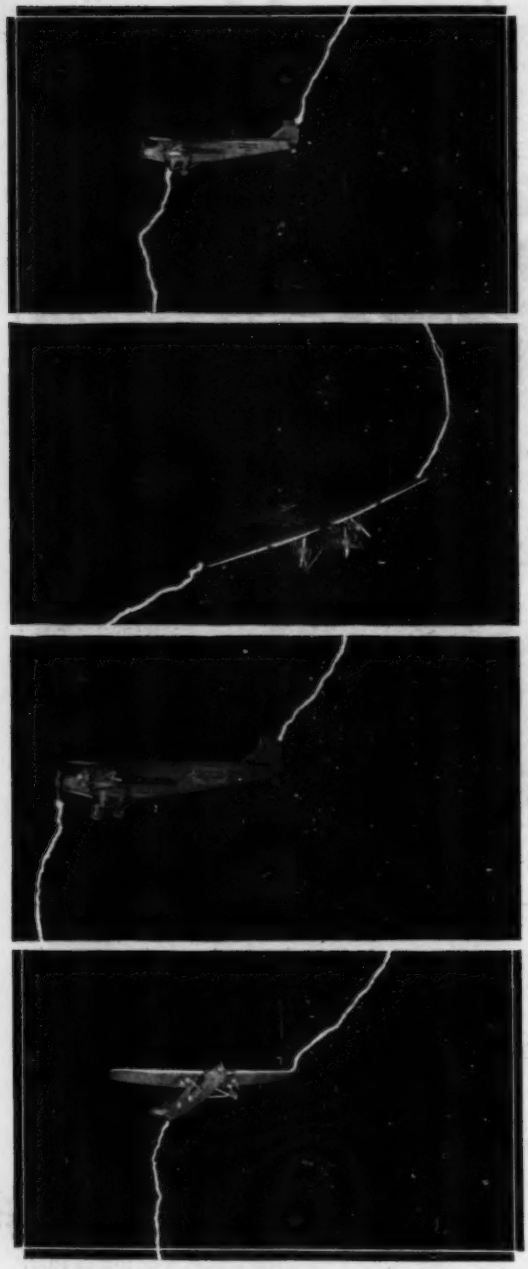
Photograph of Artificial Lightning Striking Model Plane in Tests Conducted by the Ohio Insulator Company in Conjunction with Popular Mechanics Magazine

By JOHN DRAPER

HITHERTO unwritten stories of heroism, of single-handed battles against the forces of nature and of the thrills of flying, have been brought to light by a questionnaire sent by Popular Mechanics Magazine to more than 8,000 licensed pilots to learn their actual experience with lightning.

Many of the pilots contended that lightning could not strike an airplane in flight, although it is positively known that eight balloons have been destroyed by lightning in the past nine years. While Zeppelins have been struck more than 100 times, none has been wrecked in this way, the nature of their metal framework probably being responsible for their immunity.

In all the history of aviation, the only verified case of lightning striking an airplane in flight was reported as follows: "While flying from Paris to London with fourteen passengers, Mr. F. L. Barnard had an alarming experience. He ran into a thunderstorm over Picardy, between Beauvais and Poix. Suddenly there was a loud report as a flash of lightning struck the machine. A large piece of fabric on the lower plane was burnt, the compass was put out of action, and one engine started to miss, as apparently the permanent field of one of the magnets had been upset. On examination, it was found that, in addition to the hole in the fabric, one of the main spars was scorched, all of the



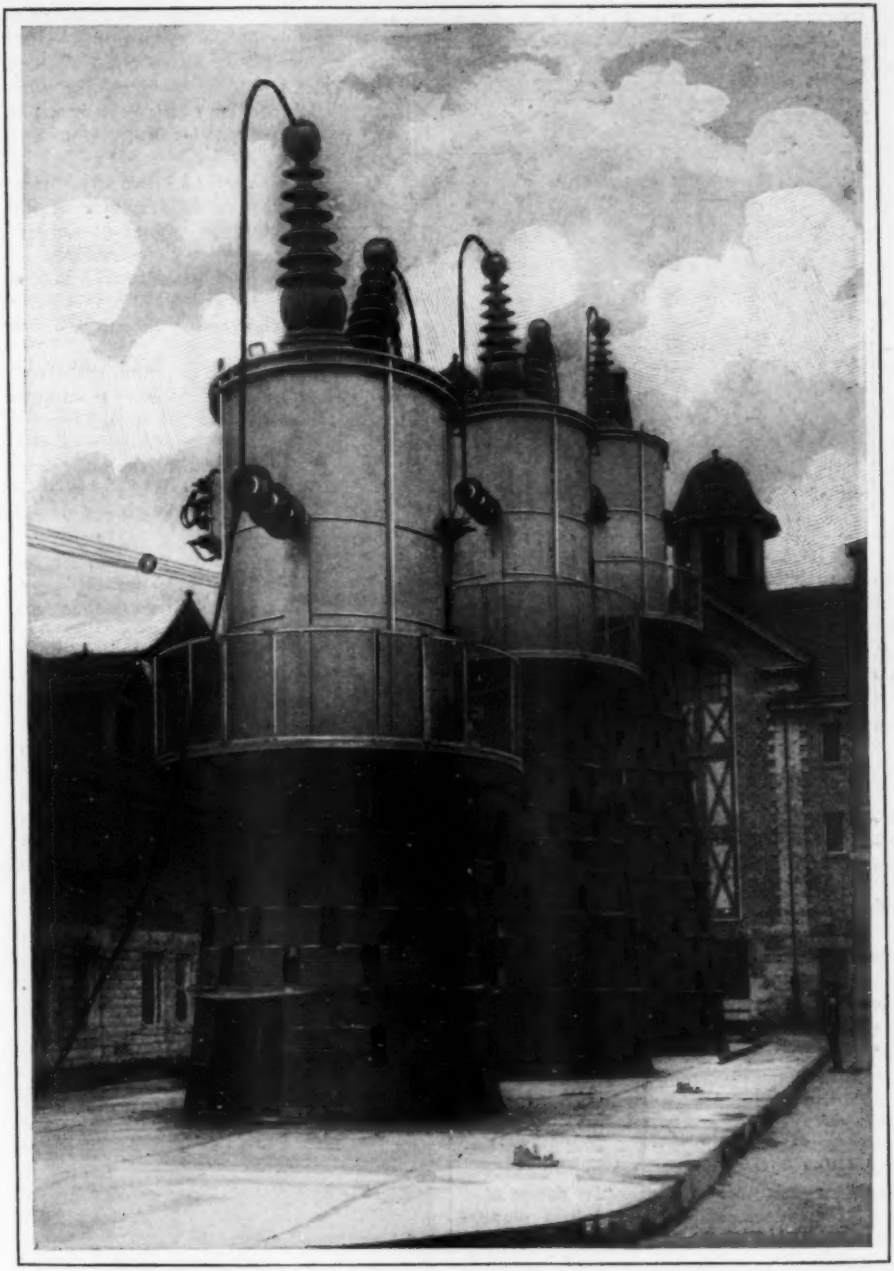
Remarkable Night Photos of Model Metal Plane Being Struck by Artificial Lightning Bolts; Note How the Charges Always Enter and Pass Out at the Tips

bonding was fused and one of the ailerons damaged."

There have been other, although not verified, cases of crashes attributed to lightning. In 1928 the deaths of Capt. Emil Carranza, Mexican flying ace, and Morris M. Titterington, inventor of the earth-inductor compass, were believed due to bolts. In the same year a mail plane plunged to earth with its motor wide open during an electrical disturbance. Although no positive proof that this was due to lightning could be obtained, observers believe the pilot was stunned by a bolt. The same is true of a navy plane which plunged into lower Chesapeake bay in 1927. The naval board which investigated the crash reported "its belief that the lightning flash stunned both pilots in the ship to such a degree that they could not recover in time to save the plane, and that it went in uncontrolled."

With mail and passenger planes now covering 84,656 miles daily, C. M. Keys, president of the Transcontinental Air Transport, recently quoted figures showing that there were 6,500 persons killed in 1928 as a result of the operation of the railways, or one fatality for 172,768 train miles. In the same year there were 368 persons killed in civil aviation, or one fatality for 191,800 plane miles, a slightly better record than was made by the railways. The actuary society of America, insurance risk experts, reported that there is only a 4,000 to 1 chance of accident when riding with a licensed pilot over a scheduled passenger route. They found that in 1928 only thirteen passengers were killed out of about 50,000 carried in such flights.

"The forces of nature cannot be eliminated, but they may be balanced, one against another," Count Zeppelin once said. Mr. Keys now declares that "aeronautical science has progressed



Multiple Transformer Banks at Outdoor High-Voltage Laboratory of the Ohio Insulator Company, at Barberton, Ohio, Scene of the Lightning Experiments on Aircraft

to the point where the only uncontrollable factor is weather, which, in final analysis remains the major cause of interrupted transportation both on land and sea." As a result, it is the invariable practice of air-transport companies to keep their planes on the ground, just as ships remain in harbor, during storms, owing to the fact that a thunderstorm may extend upward more than 25,000 feet.

"While I have never been struck," one mail pilot reported, "I have been warmed up by heat lightning while flying in storm clouds. It is similar to running up against a real hot fire. I have seen several falling meteors and also falling stars, collide, breaking up like skyrockets."

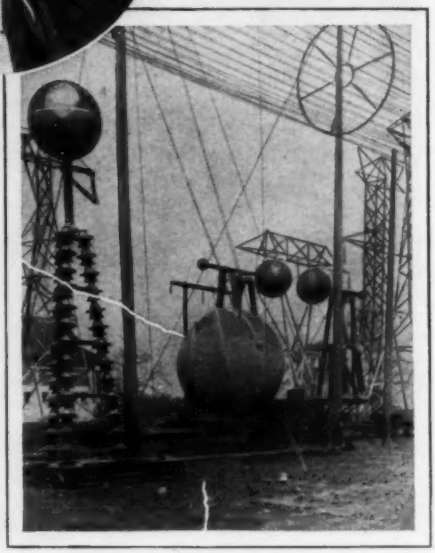
"In the older types of ships that we flew several years ago, I have noticed static sparks arcking from one wire to the other on the wings and in the fuselage," writes another pilot. "In the modern steel fuselages, I have felt a small static charge without the appearance of arcking. The sensation is anything but pleasant. It is a good time to have the old ship on the ground."

"I have flown in stormy weather only a few times," says an eastern pilot. "Outside of the bumps, or rough air, I noticed no difference. Once I tried to flirt with a thunder cloud to see how rough it might be. It was too darned rough, so now I avoid them."

"The most treacherous effect of a thunderstorm is the unstable direction of the air currents," said the official of an airplane company. "We have reports of down currents which have caused a loss of 3,000 feet in one minute. It is chiefly for this reason that nearly all pilots avoid thunderstorms."

"While flying in one thunderstorm," writes a pilot, "I noticed a heavy discharge from the metal tips on the 'prop' blades. This discharge was of a faint, bluish color and formed a narrow ring around the area swept by the propeller."

"Flying through a severe storm last year, lightning flashed all over my ship," declares another pilot. "I felt no ill effects except that I was blinded for a while."



Daytime Photo of Bolt Striking Model Plane; A. O. Austin, Chief Engineer of Ohio Insulator Company, and Test on Hydrogen-Filled Balloon

"I could not see at all for half a minute after the flash," writes the pilot of a tri-motor transport. "It was the worst storm I have ever experienced, but, other than scaring the eight passengers tremendously, it did no damage to us."

"At an altitude of approximately 5,000 feet a sudden zigzag of lightning reflected in my face, directly in the course of my ship," said another pilot. "Immediately, I would venture to say, in less than three seconds, the ship plunged violently downward, falling about 200 feet before the controls seemed to have any effect."

"Having been told that we could fly through a thunder cloud, I tried to do so but I found it impossible," writes a western pilot. "On my third attempt, I tried a power dive into the center of the cloud from above. The ship was violently thrown out by the terrific force of the boiling motion of the wind."

"I have often seen the flying and landing wires of my ship appear as though they were red-hot, an optical illusion, probably caused by a flash of lightning blinding me for a moment," says a government pilot.

To determine more exactly the lightning problem and to learn how to protect aircraft from any possible danger, Popular Mechanics Magazine has obtained the co-operation of A. O. Austin, chief engineer of the Ohio Insulator company, Barberton, Ohio, and consulting engineer for the Ohio Brass company.

Experiments are now being made by Mr. Austin with model planes, motors, parts and full-rigged ships, the results of which will appear in an early issue of Popular Mechanics Magazine.

Looking Down on the Chanin Building, New York City, from the Top of the Chrysler Tower, Which Is Higher Than the Woolworth Building

LOOKING DOWN ON THE WORLD FROM TALLEST SKYSCRAPER

Workmen have laid the last piece of steel framework for the Chrysler building in New York, which, when completed, will be the tallest habitable structure in the world at present. It rises for more than 800 feet, overtopping the 792 feet of the Woolworth building. From the dome of the $15,000,000 structure every point on Manhattan can be seen. One of the unusual sights is the Chanin building near by which, when viewed from the Chrysler building, has a startling modernistic effect, which is hardly to be expected in a skyscraper.

¶Fish, which are frozen and packed in cardboard containers as soon as they are caught, are being sold in Canada.

Above, Installation of Pipeless Air Heater; Below, Drawing Showing How Heating Unit under Floor Connects Directly with Registers

PIPELESS HOT-AIR HEATER FOR SMALL HOMES

Without any pipes to convey the heat, and requiring no basement for installation, a hot-air furnace for small dwellings now is available. The heater burns gas and the heating element proper is installed in an asbestos-covered galvanized-iron jacket between the floor joists. Installation is directly below the partition between two rooms to be heated. Two registers are provided, back to back, one for each room and each with a floor opening for drawing cold air from the floor, and a warm-air wall opening. The air is circulated through the warming chamber, and passed back into the room through the wall register without coming in direct contact with the flame. The products of combustion are conveyed through a vent to the outdoors. Three different types of lighting devices are obtainable, an electric push-button control, an automatic spark which ignites the burner when the gas valve is turned, and a pilot-and-key arrangement. One unit will heat two or more rooms and separate units may be installed in various parts of the same home.

PICTURES TURNED INTO SPEECH MAY AID DEAF TO HEAR

Pictures of spoken words, thrown onto a screen and turned back into speech recently were exhibited in New York and discussed as a possibility for enabling the deaf to hear conversation. The pictures were the sound track of a "talkie" film, magnified until the row of shadows representing spoken words was as large as a line of icicles. As this row moved across the screen, alternating lights and shadows penetrated a slit in the cloth and fell on a mirror from which they were reflected to a photoelectric cell and were turned into words. As speech translation was instantaneous, the audience was able to observe the shape of shadows that made the sounds. The possibility was expressed that at some time in the future deaf persons may learn to read these shadows which will come to represent words to them. To do this, it will be necessary to turn the moving shadows into a series of stills which the eye can see while speech goes on. Ordinarily the shadows move so fast that they are blurred. By changing the speed at which the shadows moved, the speaker's voice was made to range all the way from a grunt up through intelligible speech and to the higher keys where

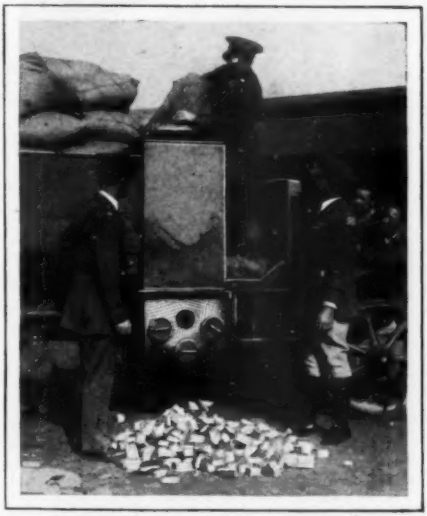
it became merely a high-pitched warble. The screen also was able to reverse speech, demonstrating that reversing the order of spelling and reproducing the sound backward are quite different because the voice pronounces sounds rather than letters.

DESERT AIR WELLS GIVE WATER

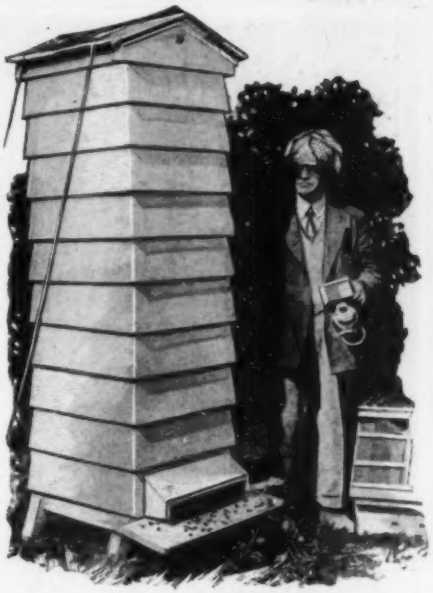
Air wells to supply water in the desert are being tested in northern Africa, based on the idea that air will condense when striking a great earthenware well, perforated and shaped like a cup upside down to create cooling drafts. The idea is not new, for investigators claim that Theodosia in Crimea, 500 B. C., built air wells that gave 3,500 barrels of water a day.

WOOD FUEL RUNS ARMY TRUCK BY GENERATING GAS

Wood has been successfully used for fuel to operate a specially built army truck in recent tests at the Presidio, San Francisco. Wooden fuel blocks are placed in an open container and burned, the gases from the fumes being passed through four cylinders and then, in the form of high-powered gas, entering the engine. The blocks were cut into small pieces for rapid combustion.



Wood-Burning Army Truck and Some of the Wood Cubes That Provide Gas to Operate It



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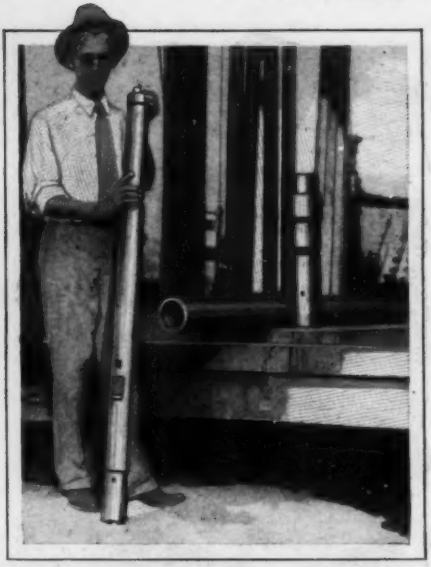
Skyscraper Beehive, Eight Feet High, with a Dozen "Floors" for the Thousands of Tenants

BEES LIVE IN SKYSCRAPER HIVE TO INCREASE PRODUCTION

Honey-producing records have been smashed by the swarm of an English bee keeper which are housed in a tall structure that might be termed a bee skyscraper. The mammoth hive is eight feet high with a dozen "floors" for the accommodation of the thousands of tenants.

ELECTRIC ICE BOX TOOTS HORN WHEN GAS LEAKS

Safety devices that make possible the operation of electric refrigerators without the danger of gas fumes have been developed recently. One of them, intended for use in a multiple system in hotels and apartment buildings, automatically shuts off the central plant when a leak occurs and at the same time sounds a warning horn as soon as one and three-quarters pounds of gas have escaped. The machine cannot be operated until repairs are made. Another safety apparatus consists of an air-tight secondary system of pipes through which any leakage is conducted to the open air.



The Man Is Holding an Underground Camera Which Shows the Course of an Oil-Well Hole

UNDERGROUND CAMERA SHOWS COURSE OF OIL WELLS

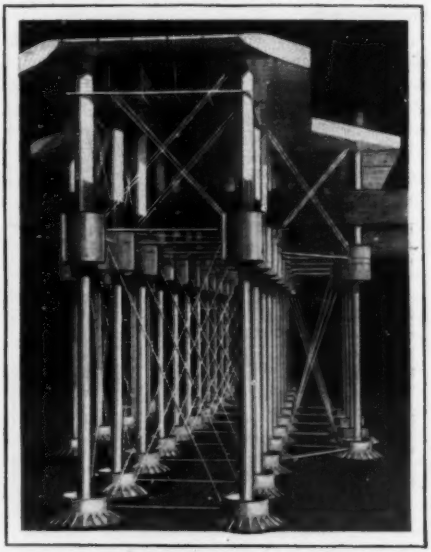
Part of the guesswork of drilling oil wells is removed by an underground camera which provides a photographic record of the course of the holes. The apparatus, which resembles a long piece of pipe more than a camera, has made possible the surveying of wells long abandoned as useless when the shaft shot off at an angle, often after it had been drilled for many hundreds of feet. Such an error naturally often led to missing production, but with the camera, drillers may drill the hole in any direction desired, and be sure it is proceeding in the intended course, by the aid of the camera.

LEFT HAND FOUND THE BEST "EYE" FOR BLIND

Contrary to popular belief, experiments have revealed that the left hand is a better feeler than the right. Blind persons read raised type more rapidly with the left hand, and the same was found true of an individual who never had been taught to read raised type. He learned to read with both hands and was able to make fastest speed with the left, slowest with the right, and an intermediate speed when using both hands. This also applies to persons with sight, because the right-handed person depends on his right hand for motor skill and uses the left for feeling. Psychologists say that the left hand is used more than the right for feeling in the dark, and for most other everyday operations where sense of touch is relied on.

SEA LEGS OF FLOATING AIRPORT PREVENT ROLL AND PITCH

Floating airports which are to be placed at 400-mile intervals between America and Europe to provide an additional safety factor in transoceanic air travel, under present plans, are to have mighty sea legs to prevent the seadromes from pitching and rolling, even when struck by the largest waves. A large-scale model of one of these airports has been constructed on land to give an idea of its appearance. The seadrome, in actual use, would project eighty feet above the water, the surface being placed on steel supports, giving it the appearance of resting on stilts. The eight airports contemplated would cost $12,000,000, each being 1,100 feet long, 400 feet wide, and 350 feet high.



Large-Scale Model of Floating Airport, Showing Sea Legs Intended to Insure Stability

Making a Talking Movie of a Crime Suspect Who Is Hidden by the Camera; Talkies Are to Be Used in Taking Confessions and Also as a Record for Possible Future Identification of Suspects

TALKIES OF CRIME SUSPECTS AID IDENTIFICATIONS

Talking pictures have been tried successfully as an aid in fighting crime by the Philadelphia police department, which has made talkies of crime suspects to aid the police or possible future victims in identification. It also is planned to use the talkie in recording the confession of a crime in an effort to show that the criminal was not tricked into admitting his guilt. Talking pictures of police characters, criminologists believe, would be a great aid in identifying them, as the voice and various views and postures would supplement the ordinary front and side views of the suspect taken by the police photographer.

TRAFFIC CONGESTION IN AIR

When more than 69,608 airplanes try to crowd their way into the sky above one square mile of land, air traffic will become congested, Earl J. Smith, of the Stinson Aircraft corporation, estimates. He believes that number of planes could be flown on forty different levels approximately 300 feet apart. On one level in one square mile, 1,742 planes could be flown simultaneously without danger.

CYLINDER TROUBLES LOCATED WITH MOTOR TESTER

Locating cylinder troubles in the Ford car is simplified with a motor tester which can be mounted on the distributor head.

Four buttons, one for each cylinder, enable the shorting of any single cylinder or combination of cylinders to determine normal firing, weak firing or misfiring. Locating missing cylinders or motor knocks also is accomplished quickly with the tester because each cylinder can be tested separately by grounding the remaining three.

The Front Drive—

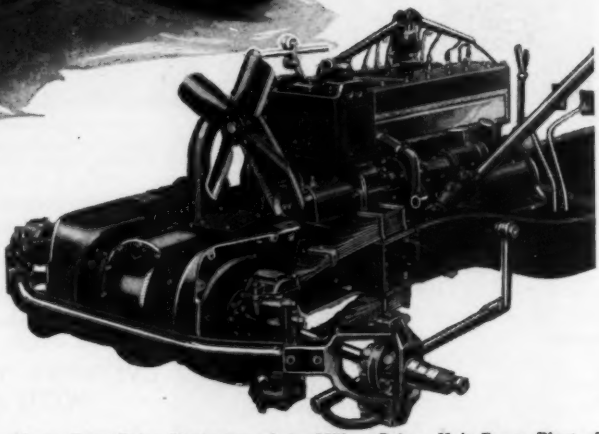
By H. F. BLANCHARD

WITHOUT question the most radical development in a quarter century of American automobile building is the advent of front-drive passenger cars.

While front drive is new to most owners, the principle itself is lost in the dim past of unwritten history. Vehicles propelled by animal power have had front drive ever since man first learned to use animals for hauling. The only notable exception is the wheelbarrow which is without doubt a much more recent invention than the drag or its successor, the two-wheeled cart of ancient times.

Nor is the front-drive automobile new in itself. It would be difficult to say who built the first one, but at least it can be stated that the first front-drive car to attract attention in this country was a racing machine built and driven about 1905 by Walter Christie, a New York engineer. Other Christie racing cars followed, and all were quite successful.

About three years ago, Harry Miller, well-known Pacific coast builder, produced a front-drive racing car which handled so well at high speed, especially on turns, and looked so smart, that many were prompted to raise the question, "Why not front-drive passenger cars?" Thus it was automobile racing, or rather the success of Miller's front-drive racing cars, that fanned up in this country the present interest in the front-drive question.



Above, Front-Drive Mechanism of the Miller; Below, Unit Power Plant of the Cord, Showing Engine, Transmission, Differential, Front Axle, Brake Drums, Spring Suspension and Steering Universal Joints

Is front drive better? Is rear drive out of date? Will all cars at some time in the future be driven from the front? The automotive industry is divided as to the answers to these questions. A certain enthusiastic minority gives an emphatic "yes" to all three. The majority, however, answer "no," while others take the

A Front View of the Front-Drive Cord, Showing Some of the Mechanism, and Clearly Indicating the Difference in Proportions between the Front-Drive and Rear-Drive Cars

middle ground, remarking, "we shall see."

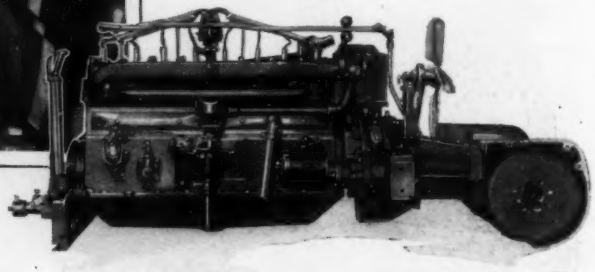
Even after all the arguments for and against have been carefully weighed, it is still impossible to say just how popular front drive will eventually become, because nobody can accurately measure public reaction. In short, just how will the public at large appraise the advantages and disadvantages of front versus rear drive after it has become thoroughly acquainted with the features of both? This article will be devoted to a discussion of the question to assist each reader in forming his own opinion.

Those who favor front drive emphasize the following structural advantages: drive at the front where it logically should be; a 100-per-cent unit power plant; a lower car with a lower center of gravity; straight frame siderails (without a kick-up at the rear axle) which provide an ideal foundation for the body; reduced unsprung weight, especially at the rear where a simple I-beam rear axle replaces the conventional pressed-steel rear axle containing the differential assembly, and elimination of the long propeller shaft.

Those who prefer rear drive reply that these advantages are not important, and certainly not sufficiently important to warrant the extra expense and complication, not to mention the necessarily longer wheelbase and resultant increased weight.

In reply, the front-drive proponents insist that theirs is the simpler construction; that all the major units are bolted together to form an integral whole; that the long propeller shaft is eliminated with its tendency to vibrate; that the relatively complicated rear axle is replaced by an I-beam; that the differential assembly is removed from the road and placed up on the frame, and that, in consequence, the bevel pinion and ring gear may be made as heavy as desirable for maximum silence, since so doing does not add to the unsprung weight.

Rear-drive engineers point out that only one or two universals are required with their construction, whereas four to six are necessary with front drive; that, comparing front and rear-drive cars point for point, front drive is more complicated and more expensive, including such minor details as gearshift mechanism, starter-crank mechanism, and so forth.



Above, Gear Shift of the Ruxton; Below, Right Side of Cord Power Plant, Showing Engine, Transmission, Differential and Front-Brake Drums as They Are Assembled before Being Placed in Chassis Frame

Each side claims to have the more accessible construction from a repair standpoint. Rear-drive experts ask, "What about your front drive when it hits a telegraph pole, with all that machinery sticking out in front?" To which the front-drive men retort: "Even so, wouldn't you rather crack up a differential than a cylinder block?"

All of which shows that there are many good arguments on both sides, although in fairness to the reader it must be added that the engineers who prefer rear drive vastly outnumber those who prefer front drive. Perhaps this is because front drive is so new its advantages are generally unappreciated, or perhaps it is because the advantages of rear drive really outweigh those of front drive.

So far we have confined our attention to a comparison of structural advantages pro and con, but of far more importance is the question as to how these differences in structure affect the actual performance on the road.

Naturally the first questions that leap to mind are: "What actual benefit, if any, is noted when you find yourself behind the wheel of a front-drive car? What are your sensations? How does it differ? To answer these questions it must first be recalled that the front drive pulls the car over the road, while the rear drive pushes. On a hard-surfaced dry road, under normal driving conditions, it is doubtful whether anybody can tell by the action of the car if the drive is at front or rear. But if some crisis arises which causes a skid, the front-drive car can be pulled out of it by opening the throttle, always assuming that the driver has the opportunity to open the throttle.

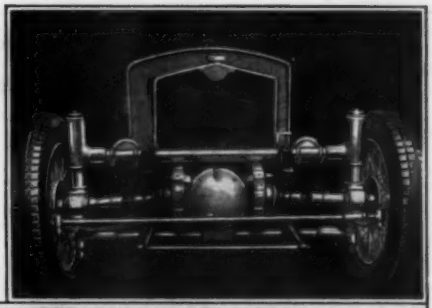
This ability of the car to drive out of a skid should be obvious, but, if not, try pushing a ruler over a table with the finger at the back end. Note that if the ruler starts to skid, considerable effort is required to maneuver it straight again, whereas if the ruler is pulled over the table by a string, and it is then swung sideways, continued pulling will soon bring it back so it again moves straight.

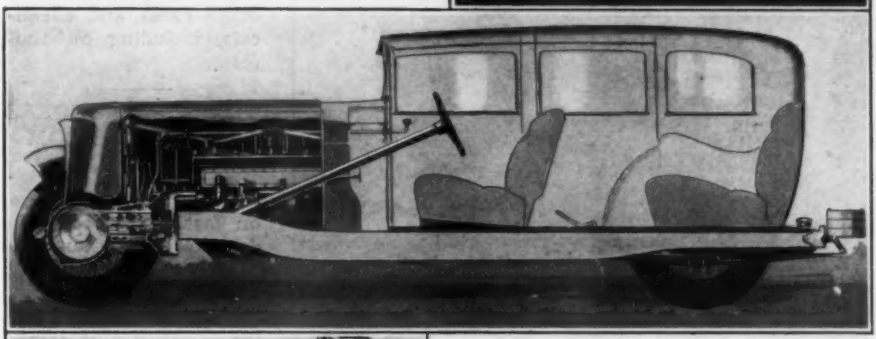
On a slippery surface of any description, whether wet, icy, snowy, muddy, sandy, oily or covered with loose gravel, any tendency to skid is immediately corrected. For example, at better than a mile a minute, the writer has deliberately zigzagged a front-drive car from side to side down a wide loose-gravel road with full control of the car. Perhaps this stunt can also be performed with a rear drive, but if so, there are few with the nerve to try it. Also, a front-drive car will pull through deep mud more handily than a rear drive.

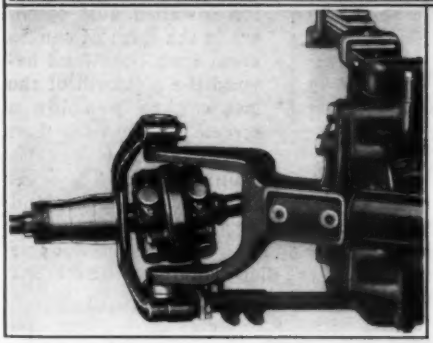
Rear-drive experts, after reading the foregoing paragraph, remark: "What of it? Everyday experience proves that rear-drive cars will negotiate the roads de-

scribed quite safely and satisfactorily. Skidding after all, is a rare occurrence. The improved performance of the front drive under the conditions described is not important." And those favoring front drive retort: "But it is important."

Because the car is pulled, it is the writer's impression that the front drive is steadier at high speed on rough roads. It has no tendency to dive off the course after hitting a severe bump. To which those preferring rear drive say: "Who







At Top, a French Design with Wheels Resting under Coil Springs; Center, Phantom View of Cord; Left, Universal Joint of the Cord

wants to drive over bumpy roads at sixty or eighty miles per hour?" Front-drive engineers reply: "All roads are more or less rough; therefore, front drive is steadier on all roads."

Due to its low center of gravity, plus the fact that the wheels are pulling in the direction they are being steered, few are likely to dispute the claim that a front drive can be taken around a curve faster without skidding than can be done with a comparable rear drive. Front-drive engineers say this is important, whereas rear-drive experts insist that on the majority of curves, the rear-drive car can be taken around faster than is safe from a visibility standpoint.

Front-drive experts contend that a blowout in a front wheel is not so serious as with rear drive. Closing the throttle of a front drive suddenly at high speed has no effect whatever on the course of the car. This statement is made because, prior to the advent of front-drive passenger cars, many believed that to do this would put the car into a disastrous skid. The steering action of a front drive is just as easy as it is with a rear drive, the delivery of power through the front wheels having no effect on steering action.

As previously mentioned, rear-drive engineers insist that all the front-drive features are actually of but slight importance and are more than offset by the greater complications. They say that rear-drive cars are already low enough, that a lower car is disagreeable to drive, that the rear drive is equally smart in appearance, especially if due allowance is made for the novelty of lowness in the front drive, and so on.

Radio Photograph of the British Dirigible "R-101," on One of Its First Flights; the Dome of St. Paul's Cathedral, London, in the Foreground

PHOTO OF BRITISH DIRIGIBLE COMES BY AIR

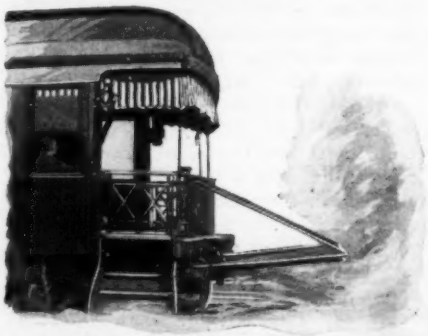
Great Britain's hope for dirigible supremacy, the giant "R-101," was entirely successful in its trial flights despite the predictions of many experts that the craft would be a failure. In its first attempt to take to the air, the ship soared majestically over historic St. Paul's cathedral, attracting the attention of all London.

CHEMICALS IN OIL-FIELD BRINE MAY PROVE VALUABLE

Salt water, bugaboo of oil-field operators, may contain chemicals as valuable as the oil it frequently adulterates. Engineers have built a plant in the Oklahoma City field to recover chemicals from the brine after announcing that the problem of separating the ingredients has been solved. The brine yields not only a high grade of common salt, but magnesium, bromide, iodine and several other chemicals, some of which can be broken up for recombination into still more valued products. Proximity to natural-gas resources also makes possible the production of other gases and chemicals, including chloroform.

TRAIN PASSENGERS SCREENED FROM ROAD DUST

Protecting passengers on fast trains from the dust and dirt that usually accompanies a trip to the observation platform, one Canadian railroad has installed dust catchers in the form of canvas aprons which extend beyond the platform of the last car, to provide a screen for the road dust swirled about by the train's speed. The canvas, extending the width of the car and five feet beyond the platform, is supported by iron pipe and attached to the floor of the car and the platform rail. The screens are not used in rainy weather.



For Added Comfort in Riding on the Observation Platforms; the Dust Screen Attached to Rear of Car

NOVEL PLANES GIVE PROMISE OF GREATER SAFETY

Above, Prof. Hans Hocke and His Entry in the Guggenheim Safe-Plane Competition, a Low-Wing Monoplane with Stabilizers at the Wing Tips to Prevent Spins; at Left, Vincent Burnelli's Monoplane in Flight; It Has Two Fuselages, Twin Motors and Four-Wheel Brakes

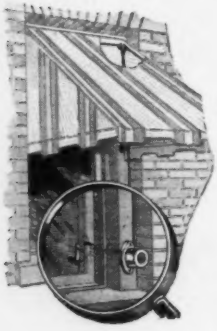
Above at Right, the Schroeder-Wentworth Competitor for the $100,000 First Prize; Its Special Wings Are Intended to Permit Unusually Slow Landings; Note the Wide Visibility from the Cabin; Below, the Cunningham-Hall "Mystery" Ship "X-89" with Low Lift Wing Which Retards Landing Speed

Class in Windmill Building for Dutch Children; It Was Organized When It Was Discovered That the Younger Generation in Holland, Land of Windmills, Was Not Being Taught the Art

CLASS IN WINDMILL BUILDING FOR HOLLAND CHILDREN

Holland, the land of windmills, found that the younger generation was neglecting the art of making them, and one town has established a well-developed course in manual training which specializes in this work. Here both boys and girls learn all the secrets of the craft so that they will be able to perpetuate it.

INSIDE CONTROL FOR AWNINGS SAVES LABOR AND TIME



Designed to raise and lower awnings from inside the window, a permanent weatherproof window fixture now may be obtained. It consists essentially of a shaft extending through the frame, a handle to attach to the inside, a winding drum, a wire cable and a cable-locking screw. When the handle is withdrawn, the awning automatically locks in place. It can be attached to existing awnings, and adds to the appearance of the awnings, while saving both time and labor.

TRANSMIT PICTURES TO PLANE WHILE IT IS IN FLIGHT

Apparatus designed to transmit pictures, weather charts and maps to airplanes in flight has been successfully tested in Berlin. First a weather chart was transmitted, enabling the pilot to determine conditions likely to be encountered on his route from Berlin to Cologne. The position of a heavy thunderstorm next was sent, and the pilot was able to estimate the speed of the storm and the time he was likely to encounter it. The third picture was that of an airport, part of which was flooded, and from the picture the pilot picked a suitable landing spot elsewhere. An exact weather chart, much more valuable than a detailed report, may be transmitted in three minutes, while sending the detailed report takes a much longer time.

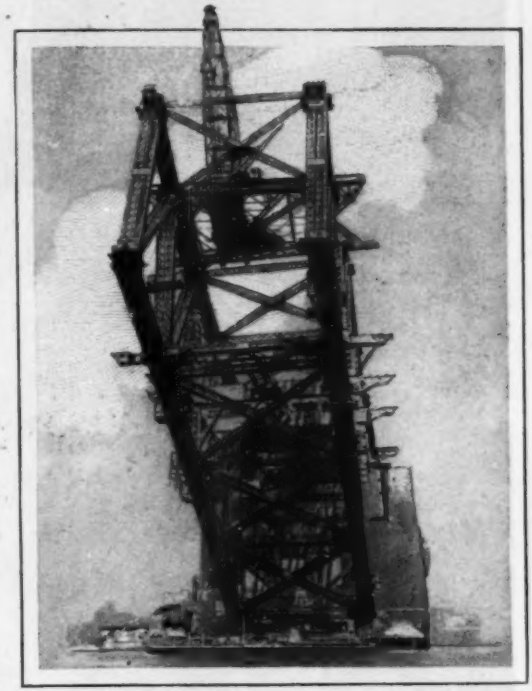
STEAM MUFFLER AND SOOT BLOWER FOR LOCOMOTIVE

Discharging steam and hot water from a locomotive downward in a tiny spray between the tracks, a muffler for the engine has been invented. Steam not only often obstructs the engineer's vision, but frequently damages coaches on adjacent tracks because the spray carries a sediment that forms a coating that is difficult to remove. An automatic soot blower for locomotives also is in use. It keeps combustion chambers and flues free of soot and cinders, the fireman turning a valve to set the blower working. The blower enables the engineer to maintain full steam.

COW WITH WOODEN LEG MOVES ABOUT EASILY

When a cow in Denmark injured its leg so badly that amputation was necessary, a professor of the Danish agricultural college fashioned a wooden leg for the animal, which now is able to move about with ease and apparently is in good health. An Oklahoma farmer who cut off the leg of his goat while mowing hay also provided this animal with a wooden leg on which it hobbles about with enjoyment.

Cow with Wooden Leg on Which She Walks About as Contentedly as the Other Animals



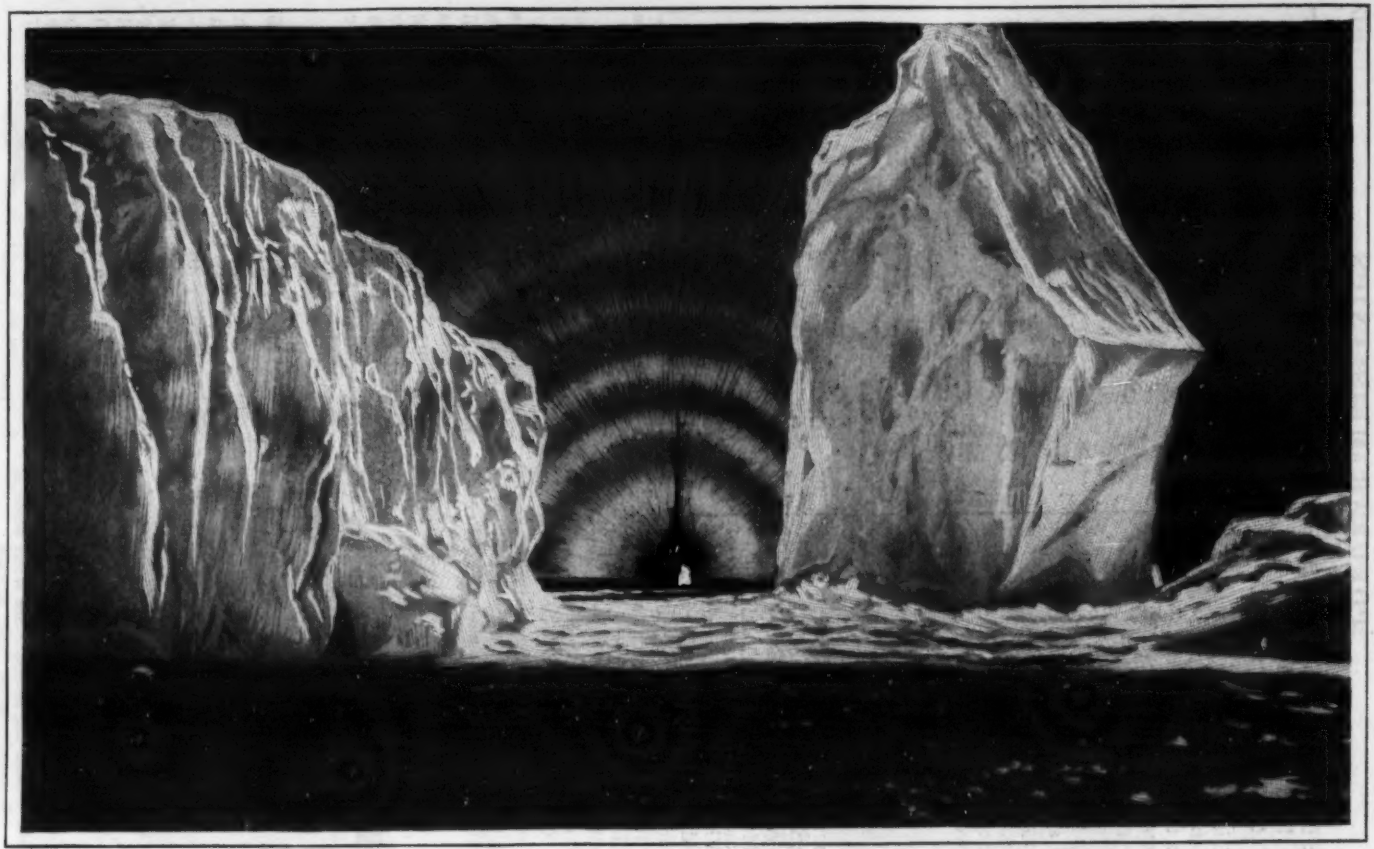
One Section of Bascule Bridge in Australia Being Constructed in Air So as Not to Delay Water Travel

BRIDGE BUILT UP LIKE TOWER WITHOUT DELAYING BOATS

Construction of the giant bascule bridge which will connect Sydney, Australia, with the suburb of Northern, is being carried on without any delay to shipping in this busy port. The building is progressing from each end with the two sections elevated in the air to allow room for ships to pass in the channel. The span will be completed in 1932.

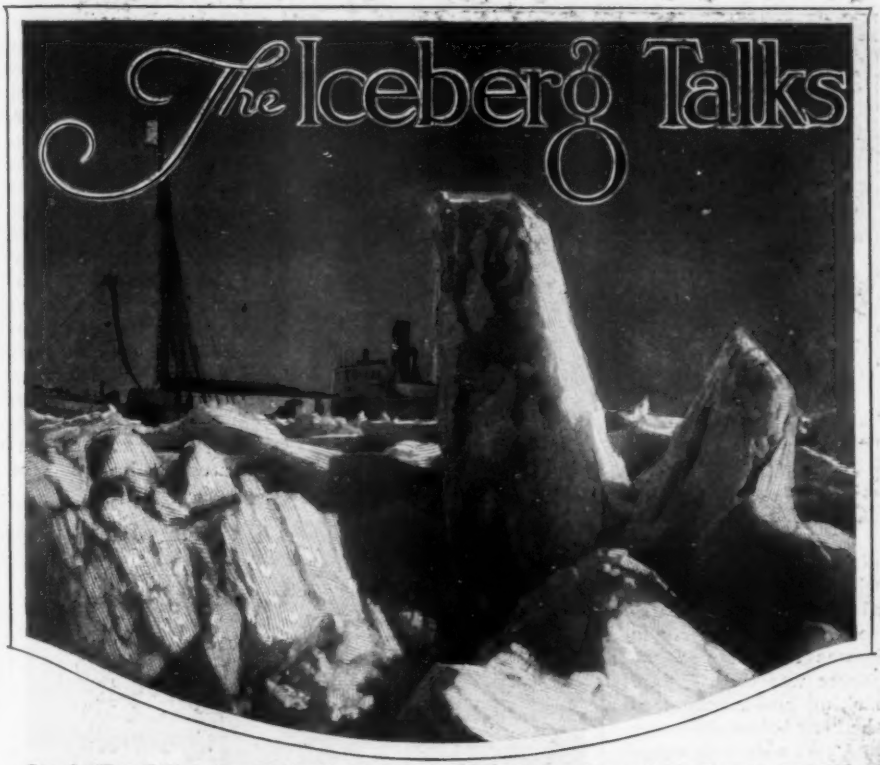
COST OF OPERATING AIRPLANES

Three passengers may be carried in an open biplane for less than ten cents a mile, according to figures of the department of commerce, based on 100 flying hours a year, or 10,000 ground miles. The plane itself costs about $3,000. Actual cost of flying an hour, equivalent to 100 miles, was figured as follows: gasoline, $1.41; oil, $.21; depreciation, $2.55; engine overhaul, $.75; insurance, $2.67; rent of hangar, $1.80; total, $9.39.



Coast Guard Cutter on the International Ice Patrol; Wireless Messages, Sent from the Iceberg Scouts, Keep Commercial Vessels Advised as to the Presence and Course of Dangerous Bergs; Due to the Efficiency of the Patrol, the Regular Lanes of Steamer Travel Are Now Securely Guarded against the Ice Peril

The Iceberg Talks



One of a Fleet of Ninety-Four Fishing Vessels That Sailed from Norway, Surrounded by Towering Ice Mountains on Its Voyage into the Arctic

THE PERIL of the North Atlantic, the annual crop of Greenland icebergs, may soon lose its terror as the result of the discovery that every berg "talks" in a voice so loud a radio microphone six miles away can pick up the noise, louder than all the noises of a ship itself.

The discovery, made off the bleak Labrador coast by Prof. Howard T. Barnes, of McGill University, Montreal, came more or less by accident.

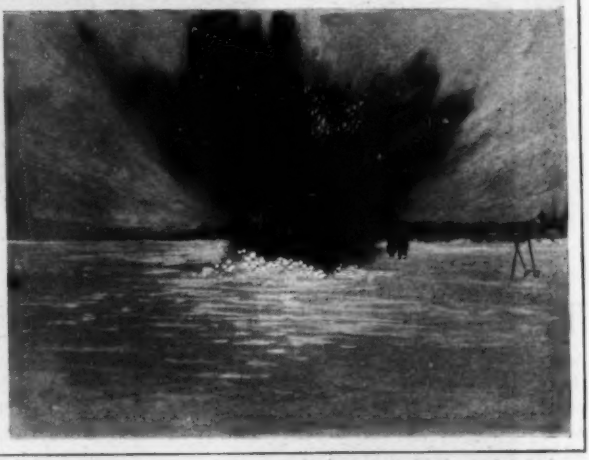
Professor Barnes, who has spent thirty years studying ice jams in rivers and icebergs at sea, has just returned with the Van Horne expedition from the Atlantic. Dr. Henry B. Faber, a chemist and engineer of New York, was engaged to try the effect of star shells, shot ahead of a ship, as a source of light against which the shadow of an iceberg could be photographed. Using parachute flares in the shells, loaded with a charge producing large quantities of fog-piercing infra-red rays, it was hoped that the system would enable ships to detect icebergs in their path despite the densest fog. Practical tests showed that the 50,000 candlepower generated by the flares did not give sufficient illumination, when fired a mile in advance of a ship.

An iceberg is ten per cent air—air that is thousands of years old and was trapped with the snow that fell ages ago on the high icecap of Greenland. When the berg begins to melt in the warmer water off Labrador and Newfoundland, the released air comes to the surface with a hissing sound plainly audible at a considerable distance, when there are no ship noises to drown it out. Professor Barnes hoped that a high-frequency microphone would be able to pick up the hiss from under the sea. The tests were disappointing, for the sound could not be heard, but a low-

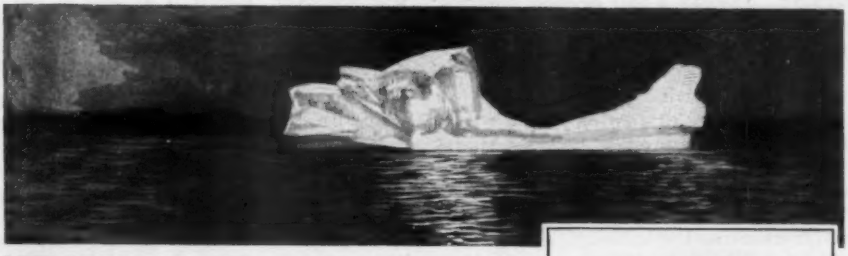
Doctor Barnes' discoveries in his study of ice upset many generally held notions about water and its frozen relative. To begin with, the commonly taught statement that water is two parts hydrogen and one part oxygen, is true only when the water is in the form of a vapor. As soon as it becomes a liquid, its structure changes. Instead of single molecules of hydrogen and oxygen it becomes a mixture of double and triple molecules, and as its temperature is lowered, the number of triple molecules increases, until, when they reach thirty-seven per cent, visible ice begins to form. The molecular rearrangement in the water at this point occurs so rapidly that a temperature change of only one-thousandth degree is sufficient to form ice or melt it. It is on this fact most of Professor Barnes' work in breaking up icebergs, ice jams and keeping power-house channels free of ice, is based. The danger point being limited to such a minute fraction of a degree, the most delicate thermometer cannot give

pitched microphone which had been taken along unexpectedly developed a loud noise, and it was discovered the source was the constant melting and cracking of the berg below the water line. At a six-mile range it was found the noise of the melting berg could be clearly separated from all sounds on the ship.

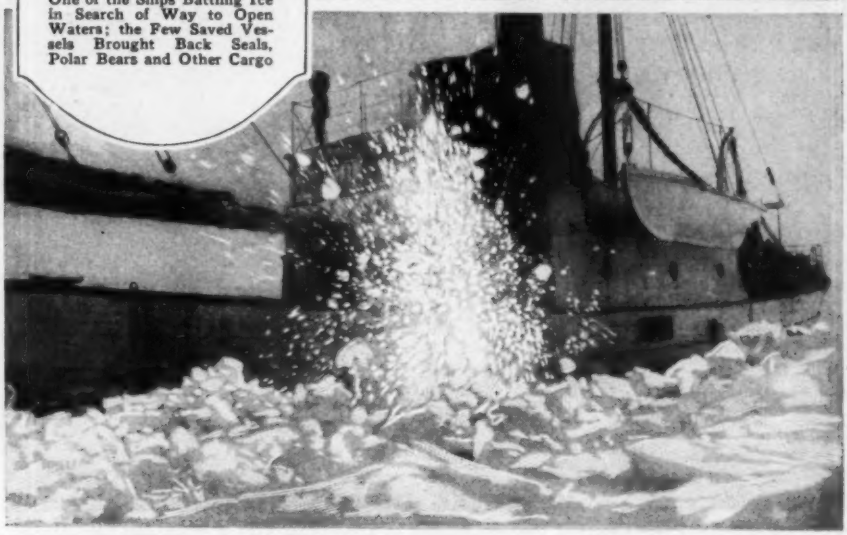
Professor Barnes' work with ice in recent years has made him the leader in the new profession of ice engineering. Among his exploits have been flood control along the St. Lawrence, where immense ice jams yearly backed water up across valuable farm lands, and the removal of a twenty-five-mile jam in the Allegheny river, at Oil City, Pa. In the latter instance, the ice had lifted a bridge two feet off its pier, but by applying thermite, a mixture of aluminum powder and iron oxide, which develops a temperature of 5,000 degrees, Doctor Barnes disrupted the jam so skillfully that the bridge was lowered onto its piers without damage, and then the jam was cleared out.



Planting Thermite, a Powerful Ice Destroyer, in a Frozen Area, and Photograph of a Charge at the Moment of Explosion



Remains of an Iceberg after Partial Destruction with Thermite, and, Below, Crew of Fishing Vessel Leaving Doomed Ship; the Craft Was Cut in Two by Crushing Ice Masses That Destroyed Thirty-Four of a Fleet of Ninety-Four Vessels Which Sailed into Danzig Strait on a Hunting and Fishing Expedition



One of the Ships Battling Ice in Search of Way to Open Waters; the Few Saved Vessels Brought Back Seals, Polar Bears and Other Cargo

warning. Instead a ball of steel wool or the frayed end of a rope, immersed in the water and then withdrawn for inspection, is more effective than any temperature-recording device.

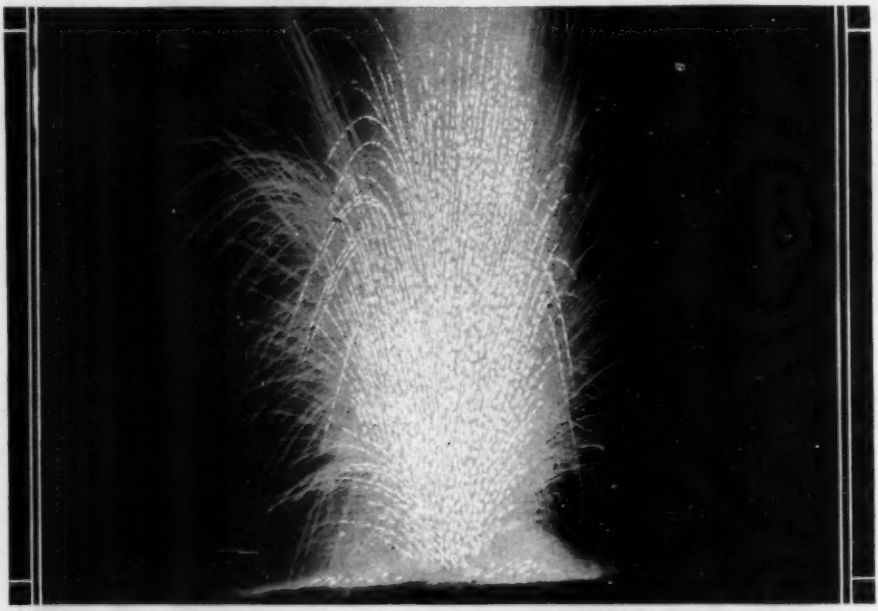
The ice molecules floating in the water readily attach themselves to any sharp point. A ball of steel wool will collect this "frazil" ice, as it is called, long before any ice appears on smooth surfaces, or as anchor ice along the banks.

The problem of breaking up an ice jam or an iceberg is not one of melting down a large part of its mass, for that would be impossible, but is one of setting up strains within the ice that will cause it to break up and let in streams of water which will wash it away.

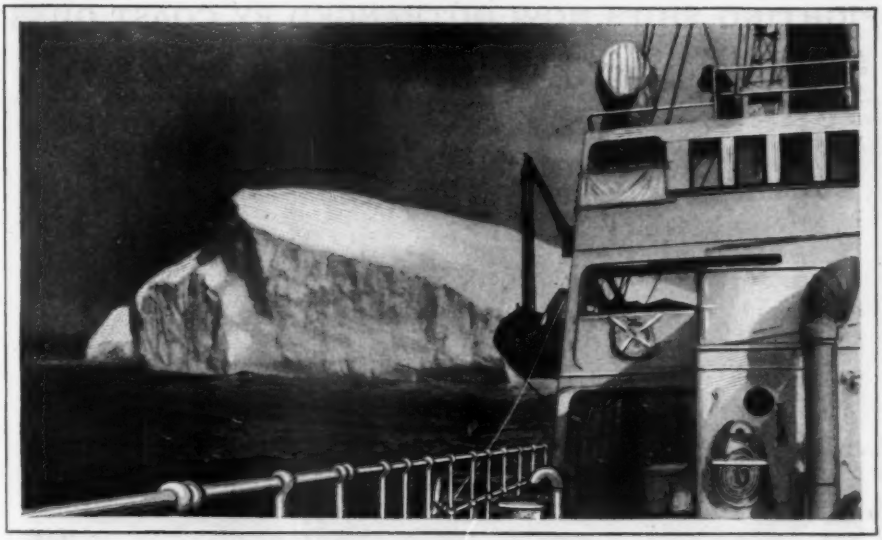
Doctor Barnes' first experiments were made with cans of thermite, in charges ranging up to 100 pounds. Thermite costs forty cents a pound, so even in charges of that size it is no more expensive than dynamite, and far more effective. The cans were lowered into shallow holes, chopped with an ax in the ice, and then touched off with a fuse and small charge of flashlight powder. Thermite normally will not burn, nor is it explosive, but if any portion of it comes in contact with a heat of 2,800 degrees, a violent chemical reaction takes place—the combining of the iron, oxygen and aluminum powder—which produces a temperature of 5,000 degrees and gives off streams of molten steel.

When a thermite charge is touched off in ice, this enormous temperature literally decomposes the ice into oxygen and hydrogen, and the latter is ignited and burns as a gas, flames leaping 100 feet or more into the air. An iceberg, 500 feet square at the water line, was broken up with a single charge of 100 pounds of thermite. A million-ton jam in the St. Lawrence yielded in nine hours to two ninety-pound charges.

Doctor Barnes has developed a new material, which he calls "solite," that is even more effective and has the added advantage that it need not be touched off hy a fuse or electric battery. Using it, loaded into bombs, it is possible to fly over an ice jam or berg and plant charges where they are needed, without danger to the users—an important factor, as it is impossible to board an iceberg in rough



A Two and One-Half-Pound Charge of Thermite Reacting on a 400-Pound Cake of White Ice; the Chemical Produces Intense Heat That Shatters the Ice



Coast Guard Ice Patrol Cutter "Tampa," Passing a 500,000-Ton Iceberg in the North Atlantic Not Far from the Steamer Lanes; Wireless Messages Are Sent from the "Tampa" Twice Daily

water, and many cannot be boarded even in calm seas.

The solite bombs are open at the top. As they plow down through the ice, there is a vacuum behind them which keeps water out, but as soon as the bomb stops, the water falls into the hole and ignites the charge. The action of both thermite and solite is due to the light waves that penetrate the ice, probably in greater degree than to the heat wave that is sent through the jam.

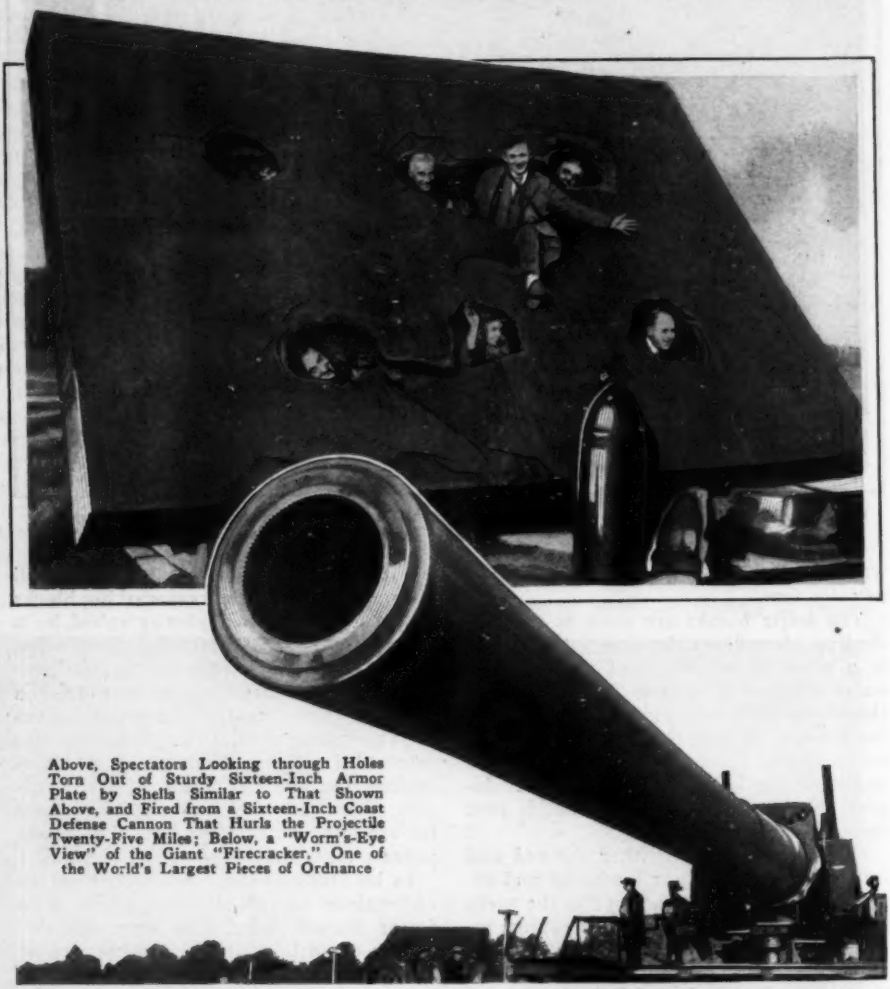
Curiously enough, neither the red and infra-red heat rays, nor the violet and ultraviolet rays at the other end of the spectrum, are most effective in breaking up ice. Instead it is the green rays and the yellowish-green ones—the rays nearest the color of the reflected light from pure ice—that do the trick.

After an iceberg has been attacked by thermite or solite, the break-up extends over a period of hours, sometimes for as much as a day and a half. Thunderous reports will be heard at intervals as the strains set up by the light rays from the incandescent mixture, get in their work. The strains are increased as the berg cools at night, and reach another climax at sunrise in the morning.

Firing of a thermite or solite charge at night is a beautiful spectacle. The small charges planted in the center of big blocks of ice disclose, when photographed by a slow motion-picture camera, just what happens. As the intense heat is first generated, the ice itself begins to glow and turn phosphorescent. The outside gives off vapor, and then, as the hydrogen gas released from the decomposed water is ignited, the block is shattered and particles of molten steel and phosphorescent ice are flung high in the air. The whole process takes only four or five seconds.

In his study of local strains as a means of breaking up vast stretches of ice, Professor Barnes found that very effective results could be obtained on sheet ice by simply spreading calcium chloride over it in a checkerboard pattern. Lump chloride is more effective than the finer flake chloride, and it is better still when mixed with twenty-five per cent of gravel or sand. To use it, Doctor Barnes employs an ordinary road spreader, and lays down lines of chloride in large squares. The chemical rots out the ice, and it never freezes again to the same strength, so that when the break-up comes, the sheet gives way along the rotted lines and passes downstream in squares of small enough size to quickly break up and avert jams.

FIGHTING SHIPS NOW OUTRANGED BY COAST GUNS



Above, Spectators Looking through Holes Torn Out of Sturdy Sixteen-Inch Armor Plate by Shells Similar to That Shown Above, and Fired from a Sixteen-Inch Coast Defense Cannon That Hurls the Projectile Twenty-Five Miles; Below, a "Worm's-Eye View" of the Giant "Firecracker," One of the World's Largest Pieces of Ordnance

The newer types of 10,000-ton fighting ships, including both the "treaty" cruisers and the sensational "Ersatz" armored ships of the German navy, are sacrificing essential armor protection for excessive gun power and, in the case of the cruisers, for excessive speed. This is the opinion of William Hovgaard, professor of naval design at the Massachusetts Institute of Technology. He has pointed out that neither class carries armor heavy enough to stop shells from eight-inch guns. The treaty cruisers all have protective decks of varying thickness—two inches might be given as an average—and their side armor varies from none at all to five or six inches. No treaty cruiser now carries less than eight eight-inch guns, and the American ships of this class are to be armed with nine or ten. Professor Hovgaard suggests cutting down the number of eight-inch guns to six, reducing the speed a

couple of knots, and investing the weight thus saved in thicker armor and a more complete torpedo defense. Commenting on the new German ships, which carry six eleven-inch guns each, Professor Hovgaard said: "The 'Ersatz-Preussen' will be supreme on the Baltic, except for the presence of a few relatively slow Russian battleships, and on the ocean she will be either much more powerful or else much faster than any other vessel, with the sole exception of a few battlecruisers."

CAGES ON WHEELS PROTECT PRACTICE-COURSE CADDIES

Caddies on one golf-practice course, where players train themselves in driving, are protected from the barrage of balls as they retrieve them by an inclosed "pushmobile" with three wheels and sides of chicken wire. Players shoot 100 balls in succession, driving down a 300-yard fairway. Formerly a bell was rung to signal suspension of shooting while an army of boys harvested the balls. With the portable protectors, however, the boys go about gathering up the pellets regardless of the shots. One lad inside the cage serves as pusher and others do the picking as the vehicle passes over the balls. Shooting from thirty-six booths, players average about 100 balls each per hour.

Caddies Retrieving Balls on a Golf-Practice Course Are Protected in This Cage on Wheels

Gloves with Gauntlet Sleeves Reaching above the Elbows Protect the Motorist's Clothes

SAVE-YOUR-SLEEVE GAUNTLETS ARE AID TO MOTORISTS

Gloves with extra-long sleeves extending to the elbows are on the market for the protection of the motorist when he tinkers with his automobile. The sleeves are made of canvas.

OVER HALF OF LUMBER IN U. S. IS BEING WASTED

In the United States about two-thirds of the entire forest drain is lost during manufacture and many woodworking industries waste from thirty to forty per cent of their raw material, the national committee on wood utilization has found. Comparative figures show that thirteen and one-half per cent of an American log is wasted in sawdust, while Sweden wastes only eight per cent. Two solutions of the problem are suggested: the reduction of waste at the source by improved machinery and increasing the uses of the waste. Last year 24,000 tons of wood flour were made from sawdust and sold to manufacturers of linoleum, explosives and artificial fibers.

e Flyers

ture of characteristics born in them, with the proper amount of making in a training school. It is possible with the Reid apparatus, used in England, to tell with a fair degree of certainty whether an applicant will make a good pilot or not. And it is possible, with the intensive study of an applicant's past history, plus some mechanical tests, to do the same thing. But in the final analysis, according to the chief flight surgeon—and his judgment is confirmed by the army air corps as a whole—the only absolute test is to take a flying course and see how you come out.

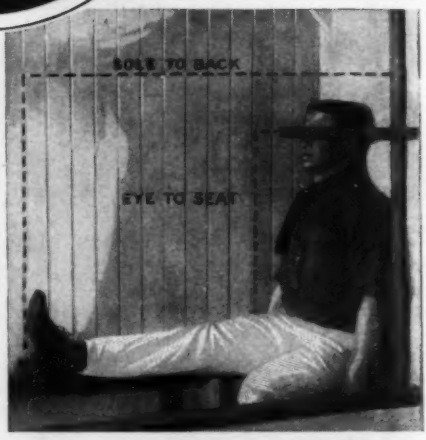
The test questions and test apparatus can weed out the hopelessly impossible applicants, the type apt to lose their own lives, wreck valuable ships and endanger

AT THE recent British aircraft show, an enterprising flying school installed a Reid aptitude indicator and gave a free test to every visitor to its booth, awarding prizes of free flying courses to the man and woman who passed with the best grades.

A man who had flown for scores of hours as an observer in France, but never had a chance to take flying lessons, won for his sex. And the woman winner was a noted ski champion, whose training had given her, among other things, a well-developed sense of balance and a keen eye.

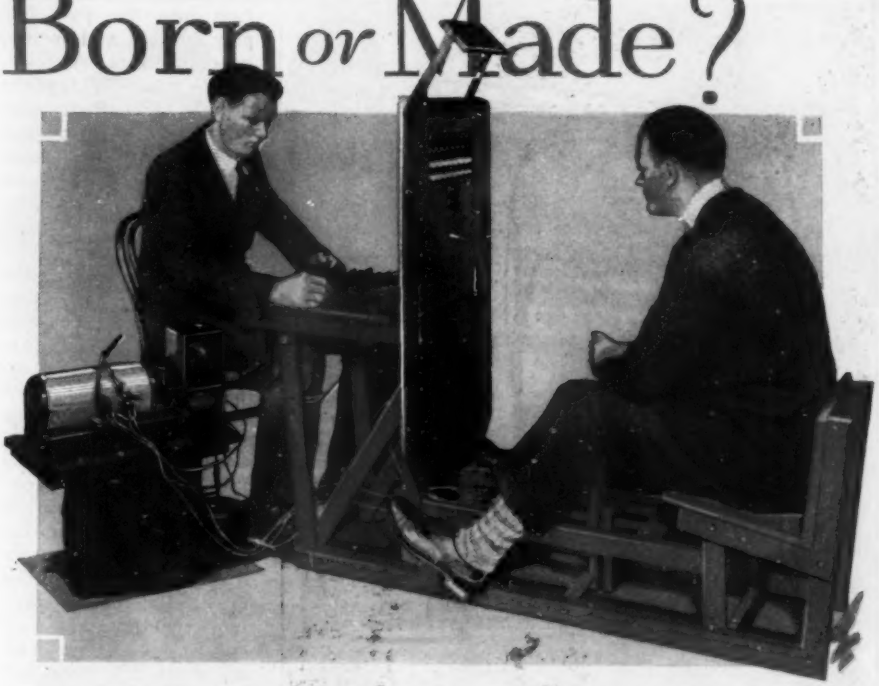
That was interesting news, but the sequel, which came a few weeks later, was even more interesting. For the woman ski expert soloed after two hours and forty minutes of dual instruction, and at the end of seven hours, was doing loops and other aerobatics. As the average dual instruction time for most students is about eight hours, the mechanical judgment of the indicator was fully confirmed.

Flyers, according to the chief flight surgeon of the U. S. army, are neither born nor made, but must combine a proper mix-



Above, Measuring a Pilot's Sight; Center, Determining the Field of Vision; Below, Apparatus to Obtain Body Measurements

Born or Made?



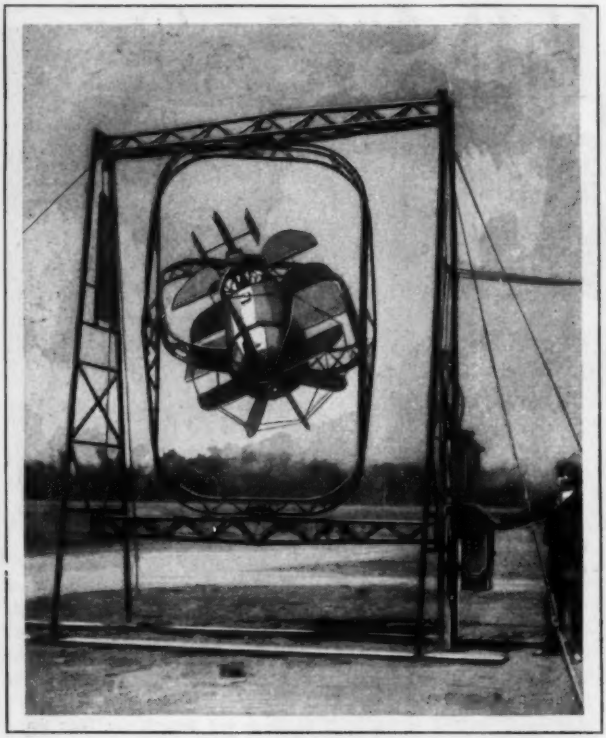
Apparatus for Testing the Mental Competency of Embryo Pilots; It Measures and Records the Time the Student Requires to React to Signals Flashed by the Light Bulbs in Front of Him

the lives of others, but of the rest, graded from excellent down through good, average and indifferent, some may improve with training, and others may not be so good as first impressions indicated.

The Reid apparatus—the invention of Flight Lieut. G. H. Reid, of the British air force—has a high reputation because it is equipped with electrical recorders that measure every reaction of the student, and because the results of thousands of tests have been correlated with the actual flying training of the same students, giving enough comparative data to confirm the machine's findings. Lieutenant Reid is also the inventor of the three-in-one speed, level and turn indicator used on the big British air liners, and of the Reid reaction apparatus, which shows up differences in the co-ordination of the left and right eyes, the two hands or two feet, or any combination of hand, foot and eye.

His aptitude indicator consists of a dummy cockpit, with control stick and rudder bar, and an instrument board equipped with a semicircle of lights above a horizontal line of more lights. The center light in each row is white and the others colored like navigation lights—red on the left and green to the right of the center. When the controls are in neutral all colored lights are out, only the white lamps burning.

In operation, the student being tested starts with the stick, moving it to one side as directed. The instructor then presses a key, signaling for its return to neutral, and electrical recorders measure what happens. If the student "overcontrols," he will pass the white line, and cause colored lights on the opposite side to come on. If he is too cautious, the recorder will mark down a series of tentative movements, and the elapsed time will exceed the permissible limit. The same process is repeated with the rudder bar alone, and then with combinations of stick and rudder. Then the course is repeated, with an



In This Apparatus the Student Flyer Meets Most of the Problems of Actual Flying without Any of the Dangers

outside annoyance, furnished by an automobile siren, to distract attention.

If the student averages 2.2 seconds to get his "plane" back into normal flight, he is marked very good; if he takes 3.3 seconds, he is average, and if he requires five seconds, he is marked down as one who is liable to crack up the ship and probably kill himself. The limit acceptable now for flight training is 4.5 seconds.

Frequently students are discovered whose hands or feet do not co-ordinate, or whose eye muscles do not co-ordinate. Some cases of eye trouble can be corrected by muscle exercises, and feet and hands can be brought to balance by repeated practice on the apparatus.

The army school of aviation medicine has an apparatus somewhat like Reid's, but without the electrical recording device, and also a number of other machines with which the medical examiner makes an exhaustive investigation into the past life, play habits and mental processes of the students.

"No machine," says the army's chief flight surgeon, "can develop aptitude for flying in some one who does not possess it to begin with. It may, however, increase natural aptitude, just as the British have improved the co-ordination of students' hands, feet and eyes, by sending them back to the Reid apparatus for practice while they were continuing their flying training.

"As a general thing, we have found no evidence that any particular race or type of person makes a better pilot than any other type. Take all the noted pilots and gather them together, and you will have tall thin men and short thin ones, tall heavy-set men and short fat ones, blue eyes, brown eyes, blonds and brunettes.

"Lindbergh is tall and thin and a fine pilot, but Lieut. 'Jimmie' Doolittle, the army's noted stunt flyer, is thin and short. The three men who flew the Atlantic at about the same time—Lindbergh, Byrd and Chamberlin—are entirely different types, and three out of four in the Byrd crew were short and stocky."

A peculiarity about army flyers, for which neither the aviation medical corps nor flyers themselves have any explanation, is that the majority of pursuit pilots, flying the small and very fast ships, are above the average in size, and a great number of the pilots flying the huge bombers are small men. There are some notable exceptions, Lieutenant Doolittle, for example, being a noted pursuit pilot, but the chief flight surgeon and others in the air corps have all noted the fact that the men who qualify for the big ships are often small, and the pilots who prove best

Two Natural-Born Flyers, Roger Q. Williams and Clarence Chamberlin of Transatlantic Fame

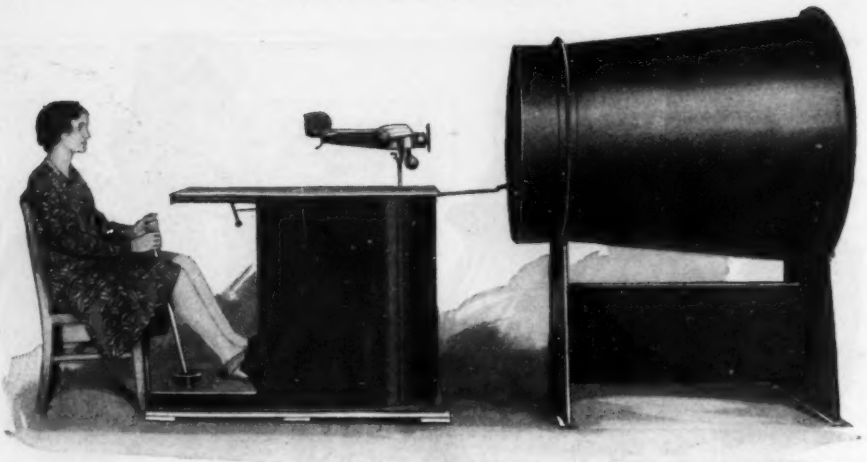
Colonel Lindbergh, to Whom Flying Is as Natural as Walking

Comm. Richard Byrd, Polar Explorer and Atlantic Flyer

Lieuts. Maitland and Hegenberger, Army Pilots Who Flew to the Hawaiian Islands

Lieut. Jimmy Doolittle, One of the Crack Pilots of the United States Army

Capt. Lowell H. Smith, One of the Pilots Who Flew around the World



The Lever Held by the Girl Controls the Model Plane When It Enters the Wind Tunnel; in This Way the Student Learns to Bank, Loop and Zoom without Any Actual Air Risk

adapted to the swift little fighters run to large sizes.

A famous English flying expert once handed down the dictum that the tall, thin, blue-eyed, blond Nordic type—the man who would make a good horseman—made the best pilot, and pointed out what a perfect seat Colonel Lindbergh should have on a horse. A survey of the famous pilots of the last two or three years, the men who have flown the Atlantic and Pacific and won fame in other notable air exploits, upsets his conclusion, for they embrace every size and shape, and include as many brown-eyed brunettes as blue-eyed blonds.

At the army primary schools, the instructors are particularly interested in the athletic achievements of the candidates, for experience has shown that boys who have excelled in games have developed the qualities that make a good flyer—mental alertness and co-ordination of the hands, feet and eyes.

The military tests are not readily applicable to students for civilian flying, for the latter does not require the high degree of skill necessary for military aviation, where pilots are required to fly in close formation, handle extremely fast ships, and execute fighting maneuvers.

So far, the examination of students for commercial flying schools has been limited to a medical examination, with particular attention devoted to the eyes. Eye troubles which can be corrected by wearing specially ground lenses in the goggles are not a bar to civilian flying licenses.

Some of the commercial schools are already going farther in order to weed out pupils who are apt to fail or damage valuable equipment, and it is possible that the department of commerce may sooner or later require a much more thorough examination than at present. Under the new regulations which permit approved schools to obtain special ratings from the department, the training of private pilots is improving rapidly.

Pilots who rate as only mediocre in army tests may prove highly successful in ordinary private flying, and average military pilots may become experts in commercial work; so, if some means could be found to weed out only the bad to impossible candidates, the others would take care of themselves, and eventually find their proper place either as private, limited commercial, or transport pilots.

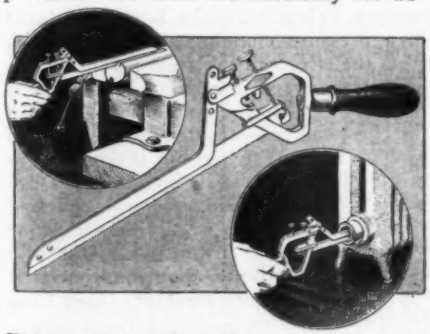
OUTBOARD MOTOR FOR GLIDER IS FORECAST

Perfection of the glider to the point where outboard motors may be attached, much in the same way as to motorboats, to provide mechanical power for this form of flying, is forecast by the aeronautics

branch of the department of commerce. Use of the outboard will require a stronger construction than heretofore, as gliders usually are made of wood or fabric, with lightness as the objective. Four American factories now are making gliders ranging in price from $100 to $700. The glider's use has mostly been limited to sport, although it has also been found helpful in scientific experiments to perfect parts of the power-driven airplane. Department of commerce specifications for gliders do not approve those without air controls, and tests are required as prerequisites of manufacturing licenses. One limitation to the use of gliders has been the contour of the country, as hilly land for taking off is necessary and forests constitute a hazard. The percentage of fatalities with gliders has been low, and many crashes do not result even in injury, due to the low speed of landing.

HANDY FOUR-IN-ONE HACKSAW CUTS ANYWHERE

Designed to overcome the limitations of the ordinary hacksaw, a new saw will work easily in almost any hole or corner. By means of two simple adjustments, the tool can be changed rapidly from an ordinary hacksaw into a keyhole saw, a saw for cramped positions or for cutting off pipe or conduit flush with a surface through which they project. The frame takes a standard eight-inch blade, which is adjustable for various depths of cut, in any position. No tools are necessary for adjustment, and the pins, riders and adjusting parts on the frame cannot fall out.



Hacksaw with Attachments Making It Possible to Cut in Almost Any Hole or Corner

EYESHIELD FOR AUTO RACERS GIVES FULL VISION

© P. & A.
Eye and Face Shield for Auto Racers, Used Instead of Goggles to Give Full Vision

British racing drivers are replacing the old-fashioned goggles, worn for years to protect the eyes, by a shield which affords the same protection not only for the eyes, but for the upper part of the face, and at the same time gives full vision. The shield attaches to the cap, and somewhat resembles a veil, except that it is of glass or other transparent substance.

BOLL WORMS GIVEN CORN DIET TO SAVE COTTON CROPS

Cotton boll worms, one of the enemies of the cotton crop, are being fed corn to save cotton by some of the cotton growers of the south, acting on advice of the bureau of entomology. The strategy was recommended when it was found that the worms, also known as corn-ear worms, seem to be even more fond of corn than of cotton, and when it had been found impossible to eradicate them, they could be drawn from the cotton fields by a near-by plot of corn for their consumption. The boll worm, also known as the tomato fruit worm and the false-bud worm of tobacco, is entirely different from the pink boll worm.

¶The average American automobile owner paid $16.53 in gasoline tax in 1928, statistics show.

UNINFLAMMABLE GAS IS USED TO BLAST COAL

Upper Left, Placing a Gas Cylinder Charge in a Coal Mine; Right, Making the Gas; Below, Setting Off the Charge

Gas is coming into use as a substitute for dynamite or other explosive in blasting down coal in mines. Carbon dioxide, a colorless, uninflammable, non-combustible gas which exists abundantly in nature is used for the purpose in a cartridge or shell. Liquid carbon dioxide is placed in the cylinder in the end of which is a hole plugged with a seal that gives way to release the gas at a certain pressure. Inclosed in the shell is a heating element consisting of a paper tube containing a combustible mixture connected by wires with an electrical shot-firing machine, while at the front end of the tube is a valve through which the liquid gas may be pumped into the cylinder. When the shell is fired and the combustible mixture ignited, the heat evolved creates sufficient pressure to shear out the steel plug in the cylinder end and the liquid carbon dioxide then expands as a gas, rushing in behind the coal and throwing it down by the force of expansion. The shell can be employed repeatedly. The gas and the shell in which it is used both have received the approval of the bureau of mines as entirely safe.

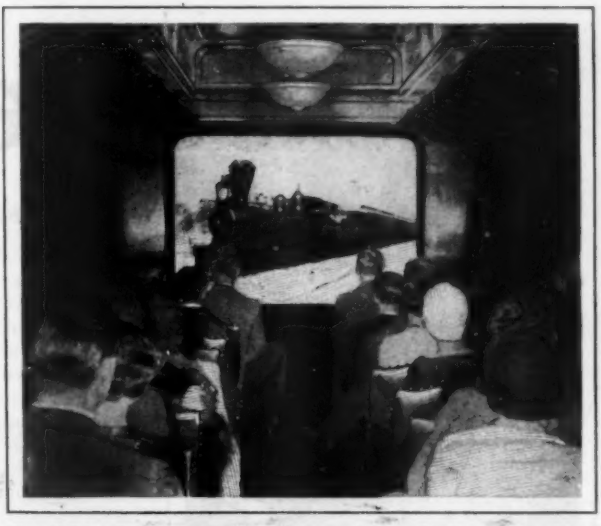
DANGER OF ALTITUDE FLIGHTS PROVED WITH RABBITS

Researches for the French government with rabbits as the subjects indicate that aviators who fly to great heights, such as 45,000 feet, endanger their lives, even though they use oxygen devices. Rabbits sometimes were found to suffer a delayed death after coming through, with apparent success, the experience of being subjected to low atmospheric pressure equivalent to the high altitudes. This was especially the case with animals subjected to exertion immediately after their experience. Experimenters set about 45,000 feet as the limit of altitude that can be reached by man when equipped with extra oxygen, unless his entire body is inclosed in a pressure chamber that shields him from the effects of the great height. When no extra oxygen is carried, 20,000 feet is the limit of safety. Soldiers wounded in the chest can be evacuated from war areas by high altitude flying, but if wounds are in the abdomen, the reduced air pressure is likely to affect them adversely. No bad effects were shown with either men or rabbits if dropped in altitude at the rate of 3,000 feet a minute, about ten times the speed of the modern elevator. Men have dropped at greater velocity without injury.

¶American paper is now being used extensively in China in making waterproof-paper umbrellas.

GAS MANTLE WAS INVENTED BY CHANCE

Luck and an accident were largely responsible for the production of the gas mantle for illumination. At first, gas was simply burned from the end of an open pipe which was plugged when the light was to be turned out. One day someone placed a thimble perforated with holes over the jet when unable to find the plug, and from this the old-fashioned flat-flame burners developed. Later Bunsen produced his famous burner by combining gas and air to give a hot, almost colorless flame, in itself useless for illumination. Then Karl von Welsbach, while experimenting in his laboratory, allowed a solution of thoria and ceria, two rare minerals, to boil over onto an asbestos pad while using a Bunsen burner and noticed that the ragged edge of the pad became a brilliant white. The Bunsen-burner principle was combined with the accidental knowledge, and gas mantles were developed by using the two minerals.



First Talking Pictures to Be Exhibited on a Moving Train; the Experiment Was a Success, All Sound Effects Being Clear and Distinct

TALKING-MOVIE SHOW ON TRAIN AMUSES PASSENGERS

For the first time talking motion pictures recently were exhibited for the amusement of passengers aboard a running train of the Union Pacific system. The equipment used was that frequently employed in movie theaters exhibiting talking pictures, and, despite the noise made by the train, the experiment was pronounced most successful, the sound effects being audible to everyone. The windows of the theater car were darkened and a screen was stretched across one end.

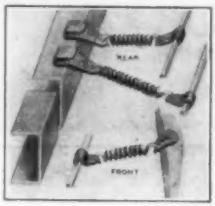
METAL STAND FOR INK BOTTLE PREVENTS TIPPING

Preventing the accidental tipping of the ink bottle, a metal support has been patented. The base has a well for holding the bottle, and a spring support fits over the bottle neck so that when it is in position, it is impossible to tip the bottle without upsetting the whole stand.

¶The heart beats more than 100,000 times in twenty-four hours.

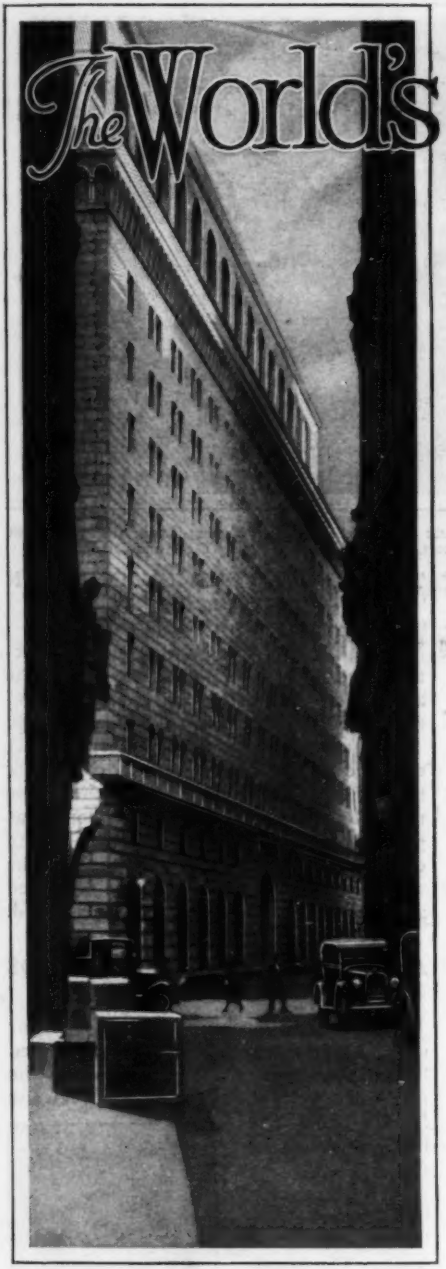
ANTI-RATTLER FOR BRAKE RODS STOPS AUTO NOISES

Rattling and clashing of brake rods or shock absorbers on Ford cars is prevented by an inexpensive attachment now on the market. The rear rod fastens between the frame and the brake rod, and the front extends from fender splash bolt to brake rod, holding the rods firmly. The installation takes only a few minutes.



The World's Greatest

By BOYDEN SPARKES



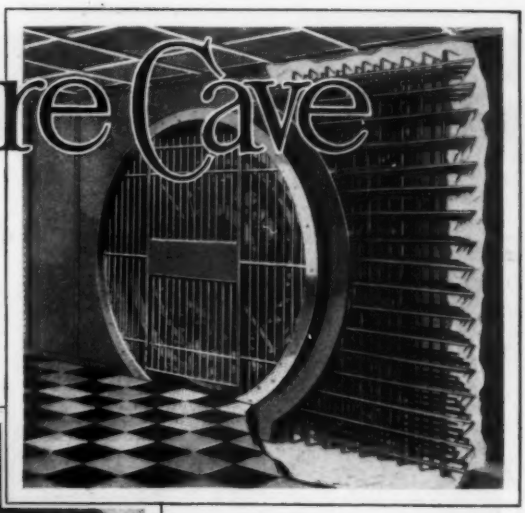
New York Federal Reserve Bank, Where the World's Largest Accumulation of Money Is Stored

THE GREATEST single accumulation of treasure in the world is contained in that fortress which houses the Federal Reserve Bank of New York. In the control room, nerve center of the compact military force which guards it, an ex-marine was listening with the receiver of a dictograph against his ear. It was past midnight. Hundreds of times before he had listened for some sound in that delicate instrument—and heard nothing. Now its diaphragm was echoing faintly an insistent, rhythmic clamor. Somewhere close by, a pneumatic chisel was biting into stone.

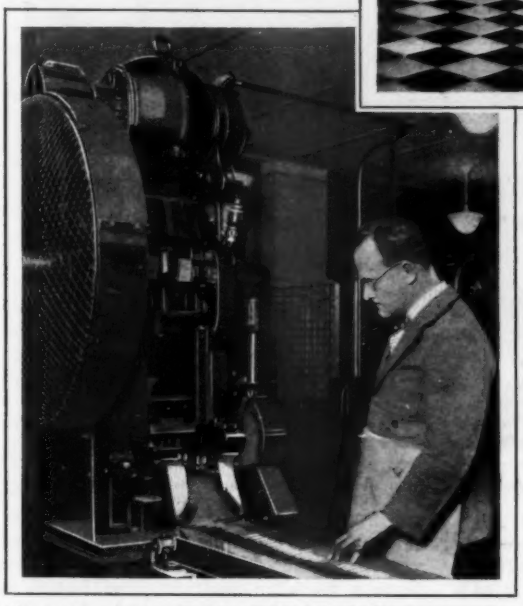
At that moment the guard felt himself to be in the very heart of the great institution. The walls which inclosed him rise fourteen stories over the most extraordinary cellar in the country. Its bottom is eighty-five feet below high curb line of the street and fifty-six feet below ground-water level. On one side of what used to be a hole there is a piece of the solid rock of Manhattan; the other three sides are held against the pressure of underground water from the East and North rivers by walls of iron rods and concrete, ten feet thick, even stronger than the natural rock. This is the hull of the bank's vault, a massive vessel, five stories deep, protected on three sides by a terrific pressure of muck and water.

Within that buried hull is the vault itself, a structure of three levels contained within walls of steelcrete—a combination of expanded metal and concrete—a construction developed particularly to protect the treasure of the federal reserve banks. The upper levels hold hundreds of millions of wealth in the form of Liberty bonds and other valuable paper. The lowest level contains gold, perhaps a fourth of the world's supply. In numerous cells, not unlike those in which convicts are caged, it is stacked in yellow

Treasure Cave



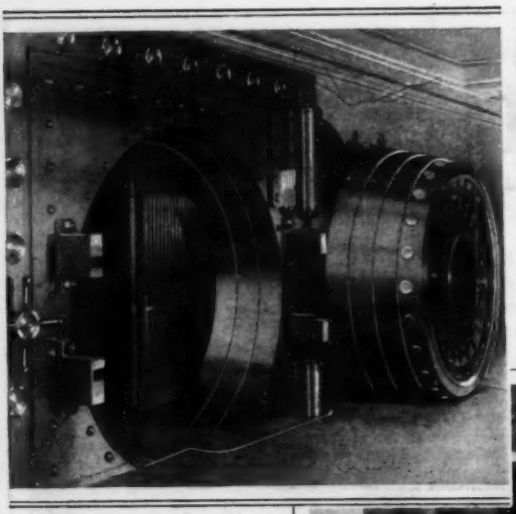
bricks. In some of the cells there are tons of it—minted double eagles in white canvas sacks. The floor on which this precious store rests, is so free from the vibrations of traffic far overhead that, if a chair is balanced on its rear legs in one of the cracks that divide the concrete surface into smooth rectangles, it will remain thus poised for weeks on end. The sound of a pencil rapped on that floor is picked up by unseen microphones in the vault and made to echo loudly in dictographs outside the vault.



Above, Cross Section Showing Typical Vault Construction; Below, Punching Machine Mutilating Old Currency

What alarm bells were rung that night, what red lights flashed I cannot say. I know that the armed forces of the institution were aroused with a speed like that with which fire fighters are called to action. Stone corridors echoed the sound of running feet. Loud commands were spoken by an unseen leader using a microphone in a concealed post of command linked by wires to the police force and the United States army post on Governor's island in the bay. Magically, where there had been quiet, watchful sentries, now there, were doubly alert, half crouching figures who clutched the finger-notched tandem grips of submachine guns. Some of this company, similarly armed, had emerged from the solid masonry of the building to reinforce the outside patrol.

At the dictograph in the control room, the ear which had first heard the cause of this alarm was still listening. The same faint, chattering noise was sounding in the receiver. The commander of the guard force on duty took his turn listening, and was quick to interpret the sound as his subordinate had done. It was, beyond dispute, the racket of an air-driven chisel. The question was, where was it operating? The answer was obtained within a tense quarter of an hour. Men who had been sent forth to investigate returned with news that air-driven chisels were being operated, legitimately, deep underground



How does all this concern you? Well, the average American has in his pockets at least a few pieces of paper money. A considerable proportion of the paper dollars in the United States are federal-reserve notes. If you possess one of these, be sure it would be simply a piece of crisp paper if it were not for the federal reserve-bank system. A part of the treasure housed in the twelve banks of this system belongs to you whenever you own a federal-reserve note. But it means much more to you than that. If you have borrowed from a bank to operate your business, likely the bank was willing to lend because this wholesale bank stands ready in time of need to buy your signed acknowledgement of the debt. More than treasure is required to make these depositories function. In New York about 2,500 men and women, numerous labor-saving machines and many strange appliances are needed for the bank's operation. About twenty-five tons of coins and five tons of paper money cross the loading platform of the bank every day in the week. This is hauled to and from member banks by from fifty to seventy armored trucks.

Above, Vault Entrance of Federal Reserve Bank; Below, Transit Department Where a Million Checks May Be Sorted Daily

several blocks away in a new subway excavation.

Such alarms are infrequent in the lives of the federal reserve-bank guard. But this does not matter. They behave at all times as if they were confronting a desperate and resourceful enemy. Thanks to the stout construction of the treasure vault, it is difficult to imagine that they will ever be called upon to defend it. Even if they were withdrawn, it would take weeks for the most expert crew of yeggmen to break into it, as the vault was built in accordance with the findings of a group of scientists of the bureau of standards, army engineers and architects. Previously, there had been tests in which every known type of construction was subjected to attack with explosives, oxy-acetylene torches that cut steel as a knife cuts cheese, and pneumatic hammers and chisels which are equally effective on concrete. As a result, it was found that a fabric of concrete and steel formed an alliance which best resisted all these forms of attack. The concrete would stop the cutter-burner and the steel would stop the pneumatic chisels and hammers.

The loading platform is within a chamber entered through iron gates such as might appropriately guard the entrance of a castle. The trucks that come there are loaded and unloaded below a long steel box that hangs from the wall above the platform. Within that slotted turret, machine gunners are concealed so that the men who handle the tons of money may work as free from fear of robbers as if they were handling so much coal or bricks.

Strapping Money with Bands of Steel Which Are Electrically Welded; Packages Are So Tight That Bills Cannot Be Removed

Within the building, not far from the loading platform, scores of workers, with the aid of machines, are engaged in sorting and counting the tons of small coins with which myriads of New York transactions are completed. These machines operate a revolving disk on which coins are poured from sacks. Centrifugal force arranges the coins along the outer edge of the disk, then they slip into slots and are channeled onto a wheel revolving more slowly, where the passage of each coin is recorded. The traffic in nickels at the New York federal reserve bank represents 27,500 pounds of dead weight each business day.

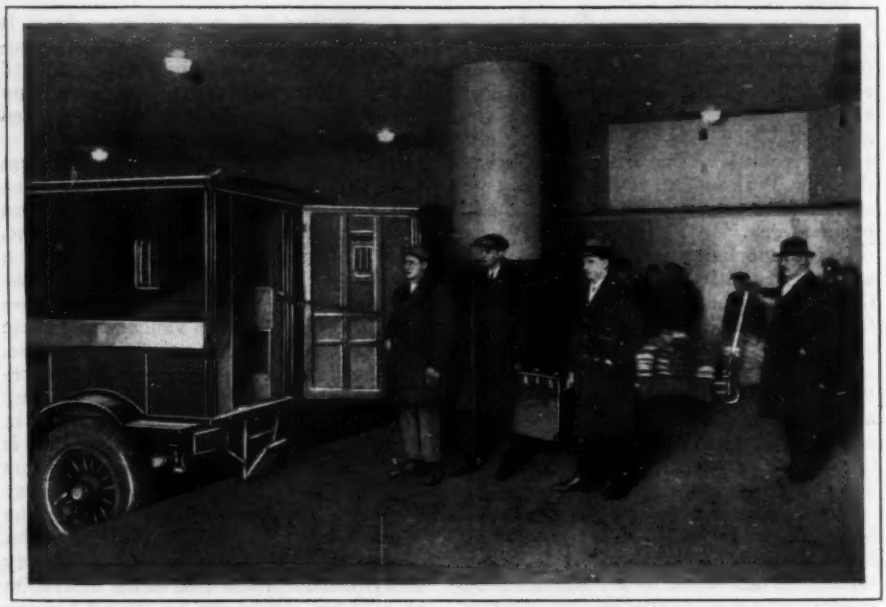
It is important that a record be kept of some of the 500,000 checks that stream through the bank daily. At the rate of 600 a minute, such checks are photographed on rolls where each picture is somewhat smaller than a paper match. Whenever it becomes necessary to examine these, the roll is scrutinized by means of a glass screen against which the illuminated picture is cast, enlarged to natural proportions.

Similar machines are used in many great banks today to record every check paid for depositors. In the past, banks were sometimes defrauded by unscrupulous depositors who would mendaciously contend the bank had charged their account with a check they had not written. As it is customary for banks to return all canceled checks at the end of the month, until this machine was invented, there was no way for banks to prove that a disputed check ever had existed.

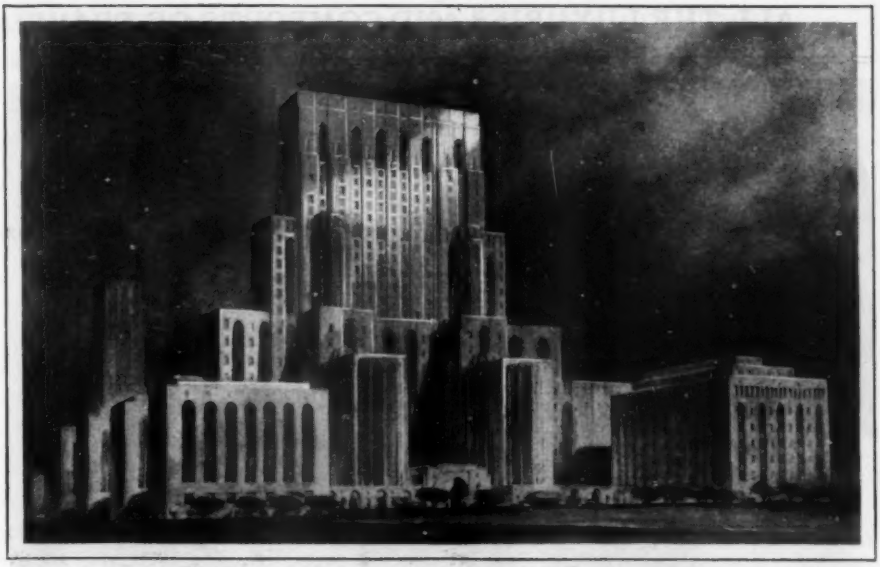
The federal-reserve banks perform many services for the nation's business, but one of the greatest is the function from which the system takes its name. Banks are required by law to reserve a portion of their assets for emergencies. Formerly each bank kept its reserves—idle money—in its own vaults. Now these reserves are mobilized in the reserve banks. The bulk of the treasure housed in a reserve bank is simply money that is being kept for member banks as that bank in turn keeps your money. The result is that, when the northwest wheat growers require a huge credit with which to pay the cost of harvesting and shipping the wheat before it has been paid for, they can get it. Whatever the need of industry or agriculture, these twelve big reservoirs of cash and credit can be tapped for the supply.

One of the chief things done with money brought into the Federal Reserve bank of New York is to count it. Without the aid of mechanical appliances, typewriters, adding machines, elevators, money counters, coin counters and other devices, so many hands would be necessary that the task would be almost impossible. For example, there is a floor where paper money is counted and sorted. This work is done by girls. In most banks today money is still counted by hand. The swiftest bank tellers are able to count no more than 12,000 bills in a day by hand. An equivalent skill, plus counting machines, enables some of the girls in the bank to count as many as 35,000 bills a day. Bankers had long talked of the need of such a machine, but after the federal-reserve system was organized, it was invented to order. Some of the bankers went into conference with a firm of machine designers. The machine was produced and is giving satisfaction. It can't make a mistake. As she feeds paper money into the six bins of this machine, in the manner of one dealing cards at a bridge table, a girl does not trouble about counting. Each machine bin simply continues to receive bills until it has one hundred. Thereafter the metal wheels which are its fingers refuse to function until the operator touches a lever. Before she does that, she drops a piece of cardboard on the counted pile. While the machines count, the girl devotes her attention to a study of the condition of the bills. Soiled and torn money is there withdrawn from circulation.

Fit money, after being counted, is packed into tight bales that contain 1,000 pieces each. The baling is done by a man operating a machine which compresses the money into tight bricks held together with electrically welded metal straps. One of the bricks weighs three pounds. If it contains $1 bills, it is, therefore, worth $1,000. If it should consist of $10,000 bills, it would contain $10,000,000. That is the form in which the paper money is stored in the big vault below street level. It is impossible to extract any of the bills thus packed without breaking the straps. If the brick contains $5 bills, the men who handle it thereafter can always guarantee that it represents precisely $5,000.



An Armored Car Ready to Receive a Withdrawal of Currency; All Large Deposits and Withdrawals of Silver, Gold and Currency Pass through This Heavily Guarded Part of the Building



Model of a Great Medical Center to Be Built in New York; It Will Cover Three Blocks, Provide Facilities for 1,000 Patients and Be a Center for Medical Education and Research

FUTURE FORTRESS OF HEALTH TO COVER THREE BLOCKS

Covering three city blocks and providing facilities for 1,000 patients, a second great medical-center project is planned for New York, to be built by the New York Hospital-Cornell Medical College association. The institution will be headquarters for unified activities in the treatment and prevention of disease, in medical education and in research. The great structure will take three years to build.

FALLEN LEAVES WORTH MONEY BECAUSE OF CHEMICALS

Autumn leaves have a definite commercial value which can be translated into dollars and cents because of the chemicals they contain. Studies conducted by the Pennsylvania department of forests and waters show that a ton of oak leaves contains two and four-fifths pounds of phosphate, eighteen and four-fifths pounds of nitrogen and seven pounds of potash. The lightest ground fire, sweeping an acre of oak forest, sends $4 up in smoke, for the nitrogen is lost, although most of the potash remains. To this must be added the value of the leaves as a forest carpet to retain moisture. The fertilizer value of the leaves, if left on the forest floor, is small, but applied to agricultural land, they have a definite worth.

OIL BURNER IS PART OF BOILER IN UNIT HEATING PLANT

Oil burner and boiler are combined in a single unit and sold as a complete heating system with the burner forming a part of the boiler by a company recently organized. The idea of selling the complete system originated after many experiments in attempting to fit proper burners to boilers originally intended for coal burning, and the discovery that, without the installation of devices to conserve the heat, much of the heat generated went up the chimney. This led to the building of a boiler intended only for burning oil, of which the burner is an integral part.

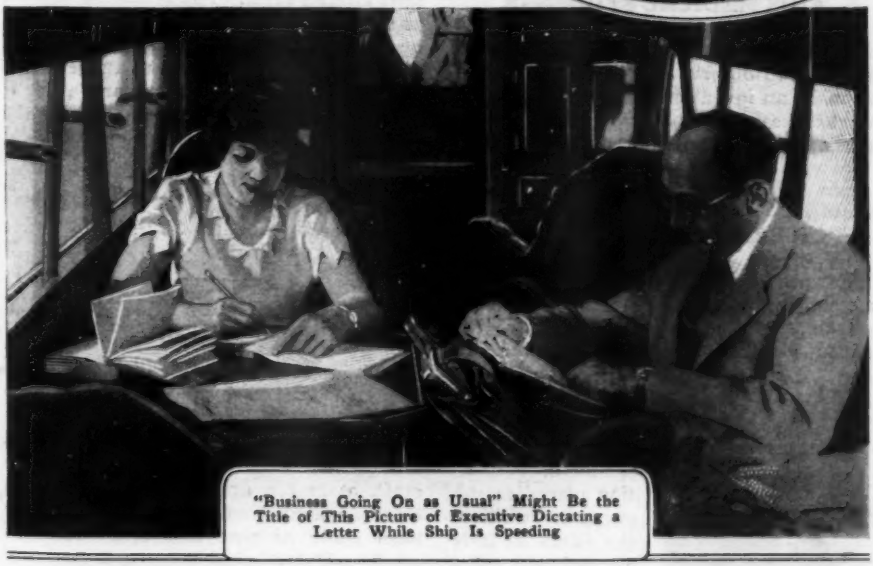
ALL THE LUXURIES AND COMFORTS OF TRAVEL

Above, Luxurious Interior of a Fokker Amphibian Flying Yacht Whose Hull Is of Duraluminum; It Seats Six Passengers and Is Equipped with All the Conveniences of a Modern Cabin Cruiser; a Similar Plane for Land Flying Is Equipped with Electric Stove, Hair-Curling Irons and Refrigerator, Radio, Bookcase, Typewriter Desk, Card Table, Chaise-longue, and Seven Roomy Seats

Above, Receiving a Marcel While a Mile High and Going 125 Miles an Hour; at Right, Ordering Lunch on a De-Luxe Ship of the Aero Corporation of California

ARE PROVIDED ABOARD THE LATEST AIR LINERS

Above, Enjoying a Game of Checkers during a Flight of a $100,000 Fokker Plane Equipped with Every Luxury of Travel; at Right, Playing Pool on a Special Table Installed in a Continental Air Express Ship; Players Say Aerial Pool Is Fast but Uncertain; on the Modern Air Liner Business Goes on as Usual if the Executive Wishes to Work, While Other Members of the Party Find Diversions



"Business Going On as Usual" Might Be the Title of This Picture of Executive Dictating a Letter While Ship Is Speeding

Left, Periscope Which Throws an Enlarged View of Operation on Screen in Adjoining Room; Operation Viewed on Screen

OPERATION SHOWN ON SCREEN AIDS MEDICAL STUDENTS

Permitting many doctors and medical students to observe an operation simultaneously, an invention now in use in Paris works like a periscope to enlarge the operation three times and project it on a screen in an adjoining room. In the past only a few persons could be admitted to an operating room because of the danger of infection, and also because most surgeons are unable to work with many persons around them. The invention, known as the scialyscope, is suspended above the operating table, and, through a series of prisms, transfers the scene to a screen, enabling each person to see clearly what is taking place. Observers also hear the surgeon's voice explaining the steps.

COMB CLEANER AND STERILIZER FOR BARBER SHOP OR HOME

For use in either barber shops or homes, a comb cleaner and sterilizer now is on the market. The comb is held in place between two rotating brushes which are turned by a handle to clean the surface and the spaces between the teeth. A solution placed in the cleaner sterilizes the comb as it is cleaned, the operation requiring only a few seconds. The cleaner accommodates any size or shape of comb.

CALIGULA'S GALLEY IS FINALLY EXPOSED AT LAKE NEMI

Pumping out the water in the Lake of Nemi in Italy has uncovered a slime-crusted imperial Roman galley of the emperor Caligula, the only vessel of Greek or Roman times known to exist. The craft, at first a gray shapeless mass, on closer examination was found to have been made of pine and other resinous woods which admirably resisted action of

the water. The lake level was lowered about forty feet to reveal the craft, which is about 200 feet long and sixty feet wide. The layers of wood are laid with remarkable art and the slaves who built it conformed in many respects to the most modern ideas of shipbuilding. The whole of the submerged hull is covered with lead, indicating the Roman war fleets had armed units. Between the metal coating and the wood hull are layers of glued wool forming a protective felt. The deck is gone, but apparently it consisted of a solid plank foundation with a thick base of cemented bricks, and a covering of marble mosaic. It must have had cabins or pavilions, the walls of which were decorated with colored glass, while roofs were covered with copper.

ARMOR-LINED BANK ON WHEELS FOR SUBURBAN DEPOSITORS

Serving a widely scattered clientele of suburban depositors, an armored bank on wheels has been put in service by the Seaboard National bank of Los Angeles. The roving bank is protected by guards armed with a submachine gun, in addition to its armor sheathing, and a teller transacts business from the motorized branch bank in many outlying sections. The auto bank is particularly popular with housewives and small shopkeepers who find it convenient to have their bank come to them.

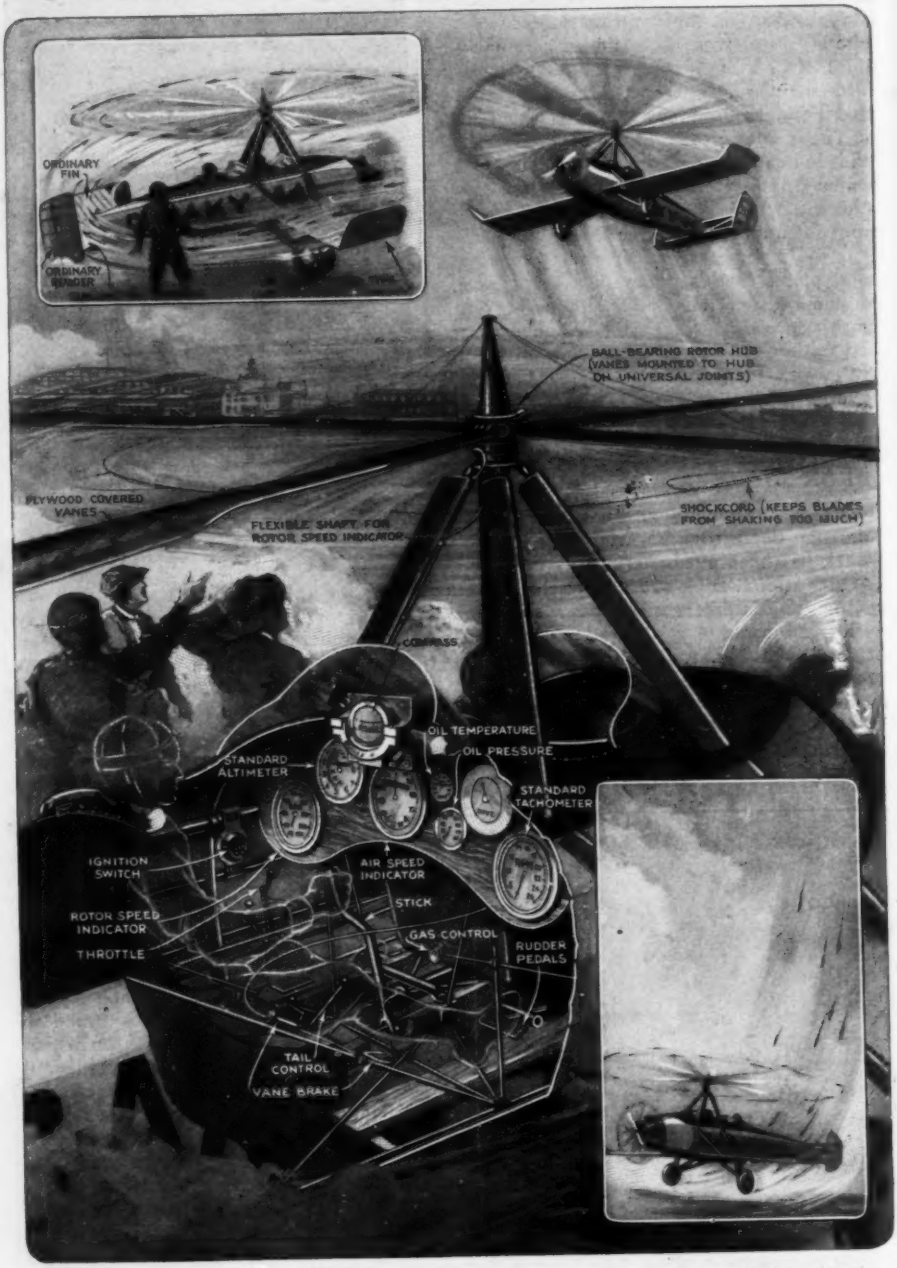
Armored Bank on Wheels Which Daily Transacts Business with Depositors in Los Angeles Suburbs, Saving Them a Trip to the Bank

Signaling Apparatus Enabling an Individual Receiver Tuned to It to Be Called by Radio

INDIVIDUAL CALLED BY RADIO AS EASILY AS BY PHONE

Enabling an individual receiver or group of receivers to be called by radio at any given moment, a radio call signal has been put in use by the Berlin police which operates like a telephone call. Experiments have shown ninety-eight per cent of all calls arriving from a 200-volt transmitter 200 miles distant were received. The calling device may be attached to any radio receiver, the call signal being made up of relatively long initial and terminal strokes between which there are some short strokes, the number, arrangement and duration of which are characteristic of each signal. The receiver is tuned to the wavelength on which the call is expected, and while it receives all impulses on this wave, the calling-up device responds only to the signal for which it is adjusted. Provision also is made for overcoming disturbing impulses which might alter the signal.

"WINDMILL" PLANE, AND WHY IT FLIES SAFELY



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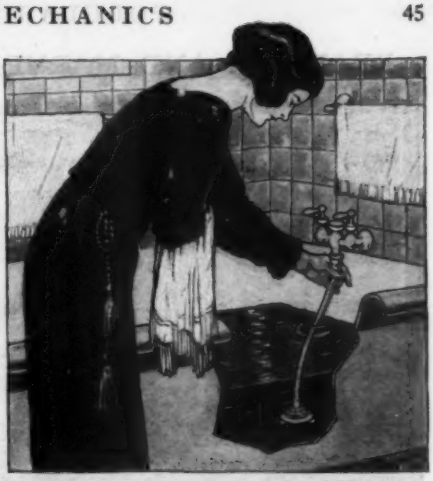
IT'S EASY TO FLY AUTOGIRO DECLARES INVENTOR

While flying a tri-motored biplane he had designed, Juan de la Cierva, a Spanish aviator, stalled and crashed. He set out to turn the disaster into good. The result is his autogiro, the aircraft with the "windmill" attachment. It is now being manufactured in this country, and has attracted wide interest. It is safer, will not spin or dive after a stall, is easy to fly, and, perhaps most important of all, it will permit the use of exceedingly small fields for landing purposes. This unusual machine with its four rotating blades can descend slower than a parachute of the same diameter as the rotor. Under exacting scrutiny by government officials, it landed, during a test in England, at an angle of eighty-seven degrees and with a speed along the path of but sixteen feet per second. The principles involved are explained by Senor Cierva himself, who likens the landing of his autogiro to that of a bird. "In descending," he said, "a glide is made which can either be flat as that of an airplane, or considerably more inclined, at will. When the ship is a few feet from the ground, the pilot pulls hard on the stick, the nose goes up suddenly and the machine stops dead in the air. It then falls gently, vertically, the tail skid touching the ground long before the wheels." The reason the autogiro settles down so gently is that the four rotating blades, whirling rapidly above the ship, perform the function of a parachute. While the craft is in flight, the rotors, being free to adjust themselves to a wide variety of air conditions, act somewhat as shock absorbers. They minimize the effect of bumps in the air upon the plane and help to stabilize it. The rotors are under no motor power whatsoever. "I believe the autogiro will be of special help in the development of civil flying where safety is paramount," says Senor Cierva. "To fly the autogiro without risk, only a few hours' training are necessary. In addition, the autogiro will make possible the utilization of very small fields as landing grounds. The romantic roof landing is no longer a dream, and I hope that, before long, we shall see autogiro parking places in the middle of the cities."



Hose with a Heavy Metal Base Which Silences the Flow of Water into the Bathtub

SILENCER FOR THE BATHTUB FILLS IT NOISELESSLY

Noiseless bathtubs now are possible with the use of a silencer attachment which smothers the sound of the rushing water as the tub fills. The silencer resembles a hose with spray attached, except that instead of the spray, the attachment is a heavy metal base with rubber supports which rests on the bottom of the tub. The water emerges from a hole in the center of the base as it comes out.

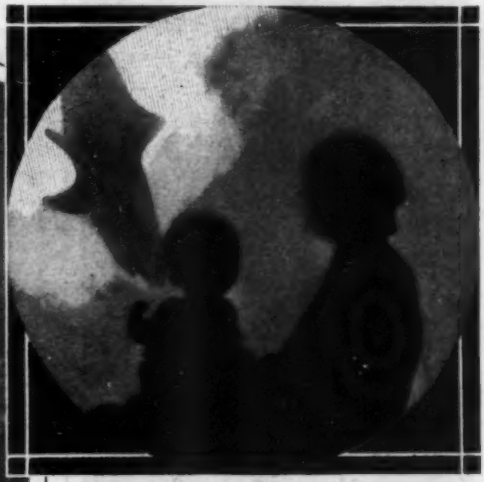
CIGARET ROLLER FOR SMOKERS WHO MAKE THEIR OWN

For smokers who roll their own, a cigaret-making machine now is available. Tobacco for one cigaret is placed in it, a piece of gummed paper laid over the tobacco and a knob is pushed forward and back to roll the cylinder. Besides being cheaper than the "tailor-made" cigarets, it is said that the home-rolled brand is also safer because the paper used with it does not smolder.

BEAUTIES AND MARVELS OF WORLD UNDER SEA

New Beauties and Marvels of the World under the Ocean Have Been Revealed by J. E. Williamson, Originator of Undersea Photography, Who Recently Returned from the Field Museum-Williamson Expedition to the Bahamas; in the Photograph Above, a Fifty-Pound Nassau Grouper Is Seen at Home beneath the Spreading Branches of a Giant Palmate Coral; at the Left, Mr. and Mrs. Williamson and Their Baby (in a Knapsack) Are About to Descend to Their Studio Far Below the Surface of the Water; the Submarine Photographs Were Made from a Compartment at the Bottom of a Long Water-Tight, Flexible-Metal Tube, Let Down to the Sea's Floor; in This Unusual Studio, the Observers Were Able to Study and Photograph the Wonderland about Them

ARE REVEALED THROUGH WINDOW OF GIANT TUBE



Above, a Leopard Shark Peers at Mrs. Williamson and Baby Sylvia, Secure in Their Glass-Walled Retreat; at Left, in the Land of the "Stone Trees," a Diver Scouts About in the Coral Forest and Is in Communication with Mr. Williamson, Who Sits Comfortably in the Undersea Studio, Photographing and Selecting Specimens to Be Gathered; Below, Colorful Fish of the Sea Shadows; Grunts, Goatfish, Yellowtails and Schoolmasters Are among the Specimens Shown in This Garden in the Coral Clumps off the Bahamas

Cigaret Case Attached to Gear-shift Lever for the Convenience of the Auto Driver

GEAR-SHIFT CIGARET HOLDER IS EASILY REACHED

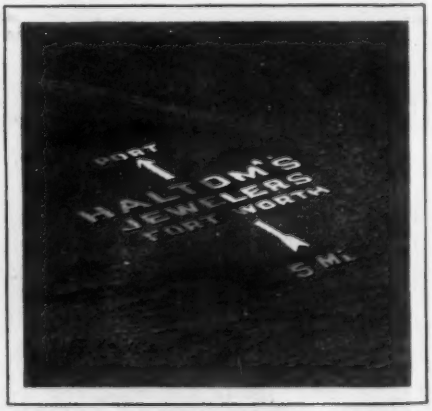
Keeping cigarets and matches at the motorist's finger tips, a cigaret case which fastens to the top of the gear-shift lever, is now available. The case screws to the top of the lever like the ordinary ball, and a twist of the round cap removes the top to leave the smokes always within easy reach of the driver. Matches may be struck on the top when it is returned to its position. It is easily attached and adds to safety, allowing the driver to keep his eyes on the road while reaching for the cigaret.

HOW FAR WILL RADIO CARRY?

Most wireless students know that a radio signal can circle the earth, but several months ago an engineer, listening to short wave signals, heard two echoes, one the ordinary echo of the signal circling the earth, and the other three seconds later. This led to experiments which revealed that echoes were heard at times varying from three to fifteen seconds after the original signal, the average time being eight seconds. As the speed of the electric wave is 186,000 miles a second, this suggested that an echo heard after eight seconds had traveled about 1,500,000 miles, or far beyond the moon. The conclusion now reached is that the signals are reflected by swarms of electrons in space, the electrons issuing from the sun and being the cause of magnetic storms on the earth. On this basis, it would appear that there is no inseparable bar to sending short-wave wireless signals to other planets, if there were anyone there to receive them, and if they could be understood.

AIR BILLBOARD CAN BE SEEN ONLY FROM PLANES

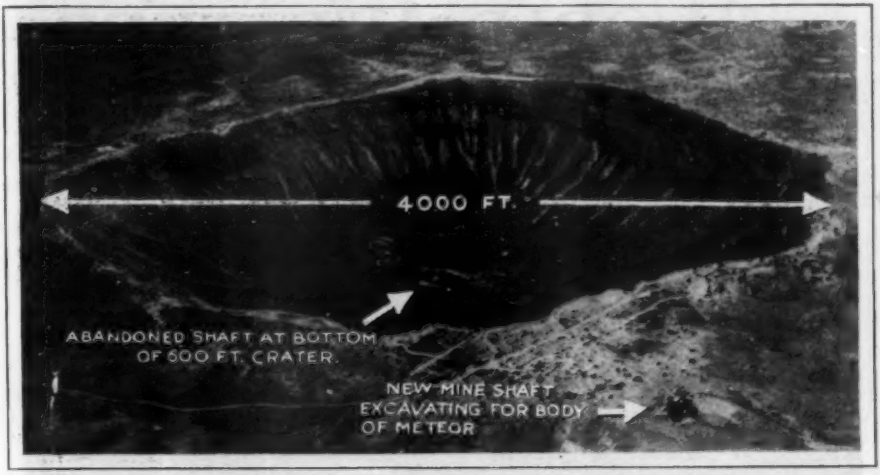
Advertisers are going after the trade of airplane passengers with aeronautical "billboards." A Texas jeweler has constructed such a sign five miles out of Fort Worth. The billboard contains the name of the jeweler, his business and the name of the city, with an arrow pointing to the airport. About fifty planes fly within sight of the sign daily. It is constructed of rock cemented together and painted white, the letters being twelve feet high, and the sign itself, in the middle of the field, is 135 feet in length. Since it is flat, it cannot be seen from the ground, although from the air it is easily readable for a considerable distance.



Aerial View of a Billboard by Which a Texas Jeweler Advertises to Airplane Passengers

One lump of copper found in the Lake Superior region weighed 400 tons.

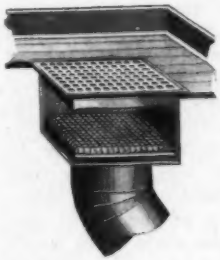
MINE SHAFT IS SUNK TO SOLVE METEOR MYSTERY



Aerial View of a "Shell Hole" in Arizona, Believed to Have Been Made by a Falling Meteor; Engineers Are Sinking a Shaft in an Effort to Locate the Body for Study

Buried hundreds of feet under millions of tons of rock and dust, a giant meteor which fell a thousand years ago near where Winslow, Ariz., now stands is believed to have been located by a mining company organized to find the celestial body. For years, a 4,000-foot crater on top of a hill in an otherwise flat expanse of desert has been the scene of explorations by scientists and prospectors. At first holes were drilled in the bottom of the crater, but this project was abandoned when it was decided the body had fallen at an angle. Another hole was then started, but it, too, was stopped when the drill became jammed in what was believed to be iron masses of the meteor itself. Finally a mine shaft was sunk about 1,100 feet south of the earlier holes, and recently it was announced a mass of iron ore had been found at a depth of 1,400 feet. Samples are said to have assayed ninety per cent iron, seven per cent nickel, and traces of platinum and iridium, and this is supposed to be the body of the meteor whose size has not been determined. Masses of nickeliferous iron have been found scattered throughout the territory, and some of them have yielded minute diamonds. The velocity of the meteor was terrific, for it is estimated that it penetrated at an angle through 2,500 feet of solid rock, exploding the rock into millions of tons of fragments. The meteor, it is believed, was not a single unit, but made up of countless iron meteorites held together by attraction. To the surprise of engineers sinking the mine shaft, water was encountered in the desert after drilling for a distance, and it was necessary to run fluid concrete into holes at the bottom of the shaft before the work could proceed. If the elements of the meteor prove recoverable, the promoters of the enterprise may hope to be amply repaid for their efforts.

HOT-AIR FILTER ON REGISTER PROTECTS HEALTH



Protecting both health and home furnishings, dust catchers for the hot-air heating plant now are on the market and may be installed in any type of register. The filter fits inside the register opening, and while allowing free circulation of air, catches the dust and dirt.

WORLD WEATHER

Radio Station in the Eiffel Tower, Paris, Whence Daily Broadcasts Are Made of Weather Reports Collected from All Parts of the Northern Hemisphere, Including Vessels in Mid-Ocean

By CALVIN FRAZER

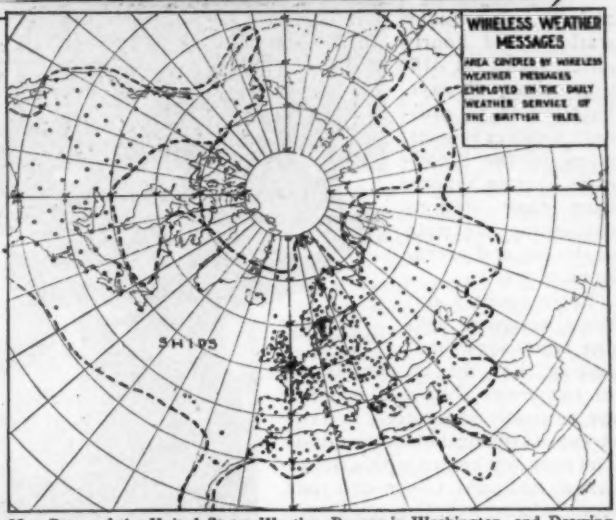
TO THE average American it is hardly of interest to know that the weather at seven o'clock this morning, Greenwich time, was rainy at Riga, Latvia, and that at the same hour sunny skies prevailed over the Scilly islands. Neither is he likely to grow excited over the news that a thunderstorm has just been raging at Constantinople, that the barometer has been falling rapidly at Apia, Samoa, and that a southwest wind blew last night at Vladivostok.

These facts have no direct and obvious bearing upon his comfort, health or prosperity, but they are of importance to him in a roundabout way, because they are part of the vast fund of current information from all parts of the world now utilized in drawing the maps from which weather forecasts are made. The wonder-working agency that makes this information promptly available is radio.

Until a few years ago weather forecasters depended entirely upon wire telegraphy for collecting the reports from which their maps were drawn. This process worked very well for assembling reports within a single country, but it was quite inadequate for the interchange of reports on a large scale between different countries. Moreover, it left blank on the weather map the vast oceanic areas of the globe and also certain isolated regions, especially in the polar zones, that were not connected with the rest of the world by land telegraph or submarine cable.

Since weather has a way of traveling rapidly over the earth, and since the weather of any one region is influenced by that of others, both near and far, forecasters have always sought to have as broad an outlook as possible upon the weather of the world when making their predictions. Long before the days of ra-

dio, there was a general exchange of telegraphic weather reports between the countries of Europe and, on a smaller scale, between Europe and North America. Reports were also received in Europe by cable from Iceland and the Azores. Great difficulties were, however, experienced in collecting information from distant regions promptly enough to be of value to the forecaster; especially in the Old World, where the messages had to cross numerous political boundary lines.


WIRELESS WEATHER MESSAGES
AREA COVERED BY WIRELESS WEATHER MESSAGES EMPLOYED IN THE DAILY WEATHER SERVICE OF THE BRITISH ISLES.
SH105

Map Room of the United States Weather Bureau in Washington, and Drawing of Area Covered by British Weather Service

The advantages of radio broadcasts as a means of distributing weather information are self-evident. A bulletin broadcast by a high-power radio station can be received simultaneously and immediately at all places within a radius of hundreds or thousands of miles where the information is required. By means of two or three rebroadcasts it can be made available with little delay over the entire globe.

At a meteorological conference held in Paris just after the World War, a plan was worked out whereby the reports of observations at the weather stations in each country of Europe, and some adjacent regions, were to be collected by telegraph or radio at a single point in the same country and broadcast by radio at a specified hour. As now operated, this plan calls for observation hours at 7:00 a. m., 1:00 p. m. and 6:00 p. m., Greenwich time, with an additional observation

Courtesy Prof. W. H. Hobbs

at 1:00 a. m. at many stations, and hourly observations at stations along airways. In addition to ordinary weather reports, many of the broadcasts contain reports from coast stations concerning the state of the sea and prevalence of ice.

Courtesy Science Service

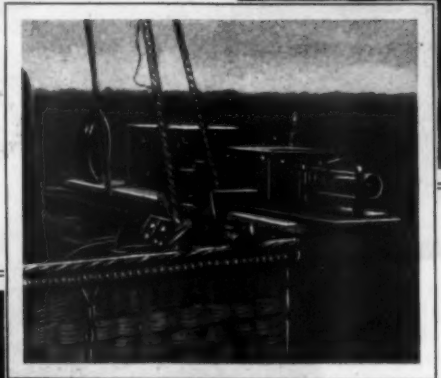
Each country has been assigned definite hours for broadcasting, but the broadcasts are so numerous that two or more are generally in progress (on different wavelengths) at one time. The program begins with a broadcast at midnight, Greenwich time, from Julianehaab, Greenland, giving the weather report for that place and four others in Greenland. Other countries follow in rapid succession, each of them broadcasting at least twice a day and some several times.

There are about 200 broadcasts every day in the countries of Europe, north Africa and the Near East, containing the results of observations at hundreds of weather stations; besides a great number of meteorological broadcasts of a more local or special character, including weather forecasts and synopses, reports for aviation, agriculture, etc. A few very powerful radio stations, including the one in the Eiffel tower, Paris, issue at specified hours what are called "international collective messages." These contain abridged weather reports from selected stations not only in Europe and the regions adjacent, but also in the Far East, North America and South America, besides many reports from vessels on the high seas. The American reports incorporated in these collective messages are taken from broadcasts made at Arlington, Va. All reports of observations are sent in code.

In nearly all other parts of the civilized world, the European example has been fol-

Top, Sending Weather Report in Greenland; Center, Broadcasting Map from Arlington by the Jenkins Process, and, Bottom, Automatic Radio Transmitter

lowed and more or less similar arrangements exist for centralizing the reports of weather observations made in each country and broadcasting them at fixed hours by high-power radio. In the United States, for example, in addition to the Arlington broadcasts just mentioned, there are broadcasts from San Francisco that include reports from western America, the Pacific and the Far East, and there are many less comprehensive broadcasts of weather reports from other radio stations. These are intended especially for the information of aviators and mariners. The weather bureau supplies mariners, on request, with base maps upon which they can chart the data broadcast from Arlington or San Francisco and thus construct shipboard weather maps of the Atlantic or the Pacific, as the case may be. Thanks to this far-flung system of broadcasts, the forecasters at Washington and at certain important meteorological centers in Europe now draw maps every day showing current weather conditions over the greater part of the northern hemisphere, and the preparation of daily weather maps of the globe is near at hand.



Drawing Weather Map on French S. S. "Jacques Cartier"; Balloon Equipped with Radio Receiving Apparatus, and Radio Weather Station near Shanghai, China

Two enterprises of special interest connected with the world's radio service are the "floating weather bureau" and the radio weather map. During the last eight years, the French training ship "Jacques Cartier," while making voyages back and forth across the Atlantic, has served as a clearing house of weather information for the benefit of mariners, and as a means of gathering reports from ships for the use of forecasters on land. Hundreds of such reports are received on board by radio during each voyage and are charted, in conjunction with reports from land sta-

Left, Radio Weather Map as Received on Board "Graf Zeppelin" during Mediterranean Cruise; Right, "Fultograph" and Specimen British Weather Map It Broadcasts

tions on both sides of the ocean. From the charts thus drawn, meteorologists attached to the ship prepare weather forecasts and storm warnings for different sections of the Atlantic, and these are broadcast on regular daily schedules. Recently the U. S. naval transport "Chaumont" has undertaken a somewhat similar service on the Pacific.

Broadcasting numerical data from which weather maps can be drawn by persons who have the time and the skill is of much less practical benefit to humanity than broadcasting the map itself, after it is drawn by experts. This process would furnish a picture of current weather over a large area of the earth to persons possessing suitable receiving apparatus anywhere by land or sea, or in the air, within range of the radio station, and they would receive it sooner than the corresponding printed weather map could be prepared and distributed at its place of origin! If, for example, a daily weather map of the United States were broadcast from Washington, it could be received by an explorer in the wilds of Canada, a mariner in mid-Atlantic or an aviator over the Rockies an hour or more before the printed Washington weather map is posted in public places at the nation's capital.

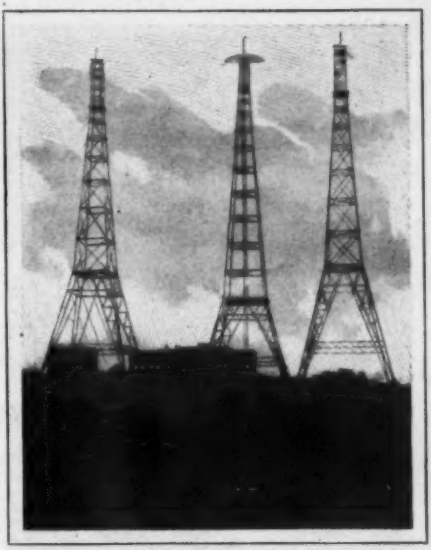
The fact that weather maps are now published and distributed every day in most large American cities, and at fully a hundred places in foreign countries, proves that there is a large public demand for the information presented graphically in such documents as compared with mere numerical statistics or text descriptions of current weather; and radio evidently offers a far more efficient means of distributing such information than the present one. Certain technical difficulties must, however, be overcome before the broadcasting of weather maps can come into general use.

The first experimental broadcasts of this

character were made in Germany. A relatively simple device for broadcasting sketches and documents, devised by Prof. Max Dieckmann, was used by the German army toward the close of the war. Eventually the suitability of this process for broadcasting weather maps was recognized, and experiments in this line were carried out by the Bavarian weather service at Munich. These proved so successful that the Bavarian service began to broadcast regularly at noon a small weather map of Europe, drawn from observations made the same morning. This broadcast has continued up to the present time. It is received regularly at several places in Germany and was also successfully received on board the airship "Graf Zeppelin" during some of its cruises over Europe.

The latest experiments in this field have been undertaken during the last year in England, where, on June 18, the meteorological office began broadcasting a weather map of the British isles and neighboring seas twice a week. The broadcast is made from the wireless station at Daventry by the Fultograph process invented by Capt. Otho Fulton. This method has recently come into extensive use in Europe for broadcasting pictures and documents of various kinds, its chief advantages being simplicity of operation, cheapness, and portability of the apparatus employed. The document, as received, is traced on a sheet of chemically prepared paper, which turns purple wherever traversed by a small platinum stylus actuated by the radio receiver.

Meteorologists are looking forward to the day when several countries will undertake to broadcast radio weather maps for specified areas, which, when fitted together, will form a "mosaic" map covering practically the whole globe. Possibly even the polar lands and seas will be well represented in this map. A large international society for promoting polar exploration by airship—commonly known as the "Aeroarctic"—headed by Doctor Nansen, has recently announced plans for supplementing the present chain of radio weather stations surrounding the north polar basin by several others to be established not only on land but also on the ice fields of the polar sea.

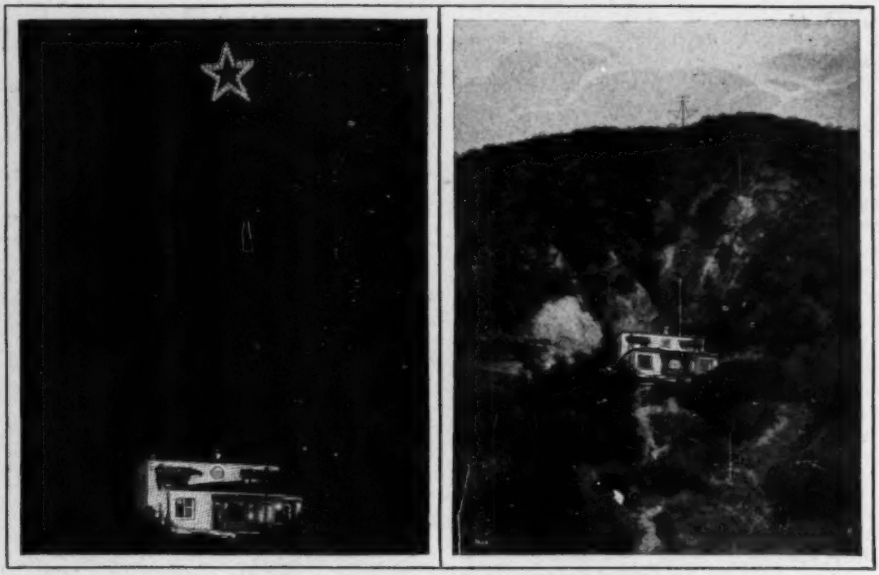


Naval Radio Station at Arlington, Va., Whence Radio Weather Reports Are Broadcast Twice Daily

At the opposite extremity of the earth it is expected that, in a few years, a series of radio weather stations will be installed on the borders of the antarctic continent and possibly in the interior, under the control of the meteorological services of the southern hemisphere. This is a favorite project of Sir Hubert Wilkins, whose recent flights in the south-polar regions were made primarily for the purpose of selecting suitable sites for such stations. The government of Argentina already maintains a radio weather station at Laurie island, in the South Orkneys, the southernmost permanently inhabited spot on the globe.

MUMMIFYING SACRED ANIMALS WAS COSTLY PROCESS

Nearly one hundred mammals, birds, reptiles and fish were regarded as sacred in ancient Egypt, and their bodies were mummified by thousands, investigators have found. The cost of this procedure was enormous. More than 200 yards of fine linen cloth, a half yard wide, were needed for wrapping one bull. Birds of the hawk and falcon type also were mummified as was a small scavenger known as the kite and above all the sacred ibis.



Night and Daytime Views of a Huge Electric Star, Twenty Feet High, Erected 1,500 Feet above Pasadena, Calif.; on a Dark Night, the Star Appears to Be Hanging in the Sky

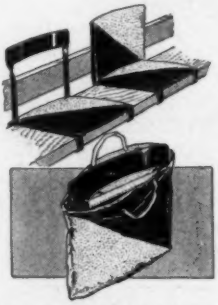
TWENTY-FOOT ELECTRIC STAR SHINES ON ENTIRE CITY

One of the interesting illuminated units in Pasadena, Calif., where Christmas lights are hung on growing trees in front lawns, is a huge electric star, erected on a hillside, where it can be seen from almost any point in the city. It is twenty feet high and shines from an elevation of 1,500 feet above the level of the town. On a dark night, the huge star appears to be hanging in the sky.

EFFECT OF EXERCISE ON MEAT TO BE SHOWN IN TESTS

Muscular exercise may have much to do with the quality of lean meat, research workers at the Illinois agricultural experiment station believe, and to determine the effects, tests have been conducted with two groups of steers of four each. The animals in one pen are each required to do about an hour's work in a treadmill every day, the equivalent of walking about four miles. The exercised steers are fed a full ration of shelled corn, cottonseed meal, silage and alfalfa hay, while the feed for the other animals, which are not exercised, is balanced to keep the weight of the two groups as nearly equal as possible. After the steers are slaughtered, various chemical and other tests will be made to determine any differences, particularly in the lean meat.

PADDED SEAT FOR STADIUM IS EASILY CARRIED



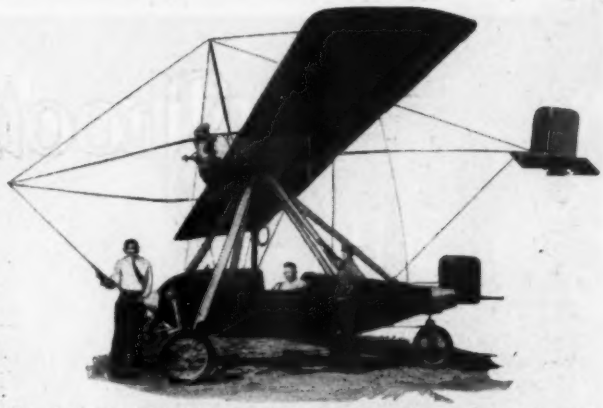
Portable grandstand seats, finished in the college colors, are now available for football fans and are attached to the ordinary benches of the stadium. The seat consists of a frame to which is fastened a cushion, the frame unfolding to form a back rest. A carrying bag in which the seat folds may be slipped over the back to form a protection for the clothing.

¶The French perfumery industry is valued at $36,000,000 a year.

HEIGHT OF PLANE IN AIR SHOWN BY NOISE

The actual distance of an airplane from the ground, as differentiated from its distance above sea level, ultimately may be indicated by a shrill noise. For many weeks, Leo P. Delsasso, of the University of California physics department, sought the particular noise needed, and now that he has found it, he is trying to devise a means of making it. He is working on an "acoustic altimeter" to enable a pilot to determine his distance above the ground, whether it be a plain or a mountain side, and his first task was to find a distinguishing sound different from any made by a plane or dirigible in flight. He built an electromagnetic analyzer which was carried in a ship and recorded every sound made. From the entire tone range, all such sounds then were eliminated, and the result shows that a relatively shrill note will be needed to attract attention. Now he is searching for a source of sound of such pitch as can be filtered through the engine noise, and of sufficient intensity to actuate a recording device. The third phase will be the building of an instrument by which the sound may be sent out and caught again when it rebounds from the earth. Then, by a computation based on the velocity of sound, the pilot will know his distance above ground.

Hunting for a Sound Whose Echo Will Indicate a Plane's Actual Height above the Ground



The Cockpit of This Ship Remains Level, Regardless of Wing Elevation; Fuselage Is Hung from Struts Attached to a Universal Joint

FUSELAGE HUNG UNDER WINGS GIVES FLEXIBILITY

Hanging the fuselage of a monoplane about six feet beneath the wings by means of six streamlined struts attached to a large universal joint behind the engine, is the method of a California inventor for giving greater flexibility to the wings. The inventor claims that this arrangement allows the fuselage and cockpit to ride level regardless of whether the craft is taking off or landing.

GERMS CAUSE FIRES ON FARMS IS THEORY OF CHEMIST

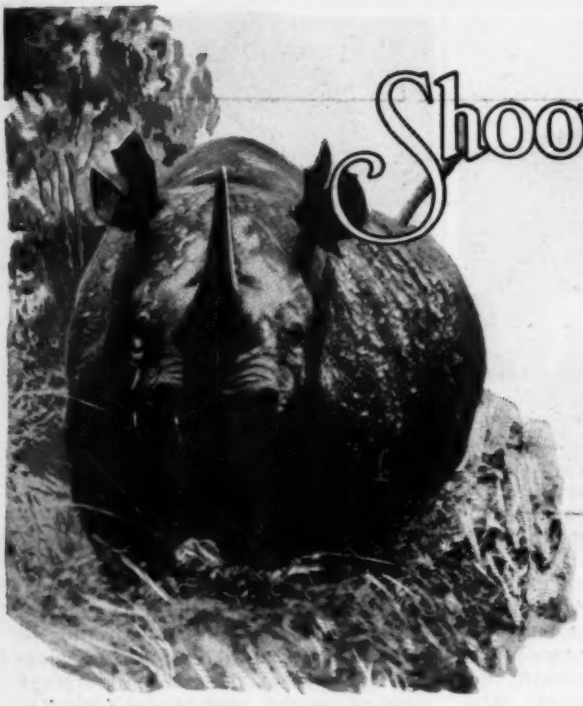
Spontaneous combustion of hay and other farm products is blamed on germs and chemical action by Dr. Charles A. Browne, of the United States bureau of chemistry and soils, who formed the theory after extensive experiments. He believes the heat which eventually results in ignition is started by bacterial action, and that real combustion occurs following the oxidation of certain compounds produced by the germs. The process commonly known as fermentation or decay is the primary step in spontaneous ignition, but the vital processes causing this are destroyed by heat of 150 degrees, while 600 degrees or more are required for ignition. Doctor Browne's theory is that the germs produce certain compounds which, by their affinity for oxygen, raise the temperature to the point of ignition.

Shooting Wild

By JAMES N. MILLER

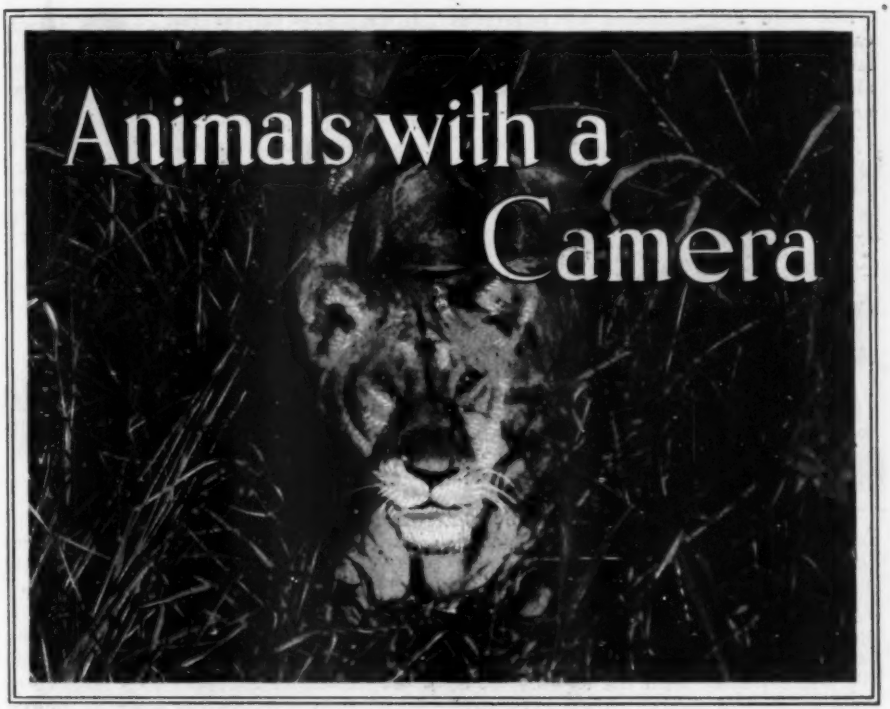
AFTER five years of almost unbelievable hardship in the dense African jungles, marked by the death of his only two white companions, Dr. Daniel Davenport, internationally known explorer, is preparing for a new expedition to the dark continent.

Doctor Davenport achieved lasting fame by taking more than 12,000 feet of motion-picture film of animals, most of which had never before been photographed in action. Moreover, he "shot" them at the very closest possible range.



Where the Camera Man Needs Courage and Cool Nerves: a Ferocious Rhino Charges and Is Snapped When within a Few Feet of the Lens; This Animal Is One of the Fiercest of All Jungle Fighters When Maddened by an Enemy

Giant Mountain Gorilla, Slain in Interior of Africa, "Posed" beside One of the Faithful Blacks of the Camera Hunter's Party; Note the Enormous Breadth of the Animal's Chest



Remarkable Action Photograph of a Lioness, "Shot" at Great Risk of Life from a Hollow Tree; the Reward of Patient Waiting in a Dangerous Position

Indeed, on one occasion he barely escaped death when bitten on the shin by a cobra in its most ferocious mood.

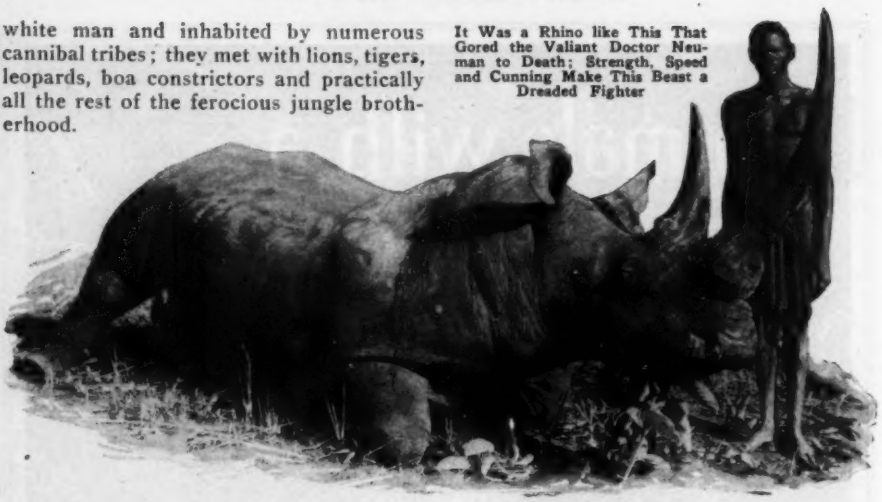
This modern epic of adventure had its beginning five years ago in Brussels. After a trip around the world and a year spent in medical research, Doctor Davenport went on a visit to the Belgian capital and happened upon a group of well-known physicians, including Dr. Louis Neuman, famous for his skill as a crack shot in the tropical wastes, and Dr. Jacques Maus, one of Europe's best-known photographers of wild beasts.

In the course of several conversations it developed that Doctor Neuman was already selecting his personnel for an expedition to study the tsetse fly in its native habitat. The wildest region of Belgian Congo was to be penetrated and its fly-infested sections surveyed in order that a battle against the fatal sleeping sickness might be organized. Already Doctor Neuman, as leader of the proposed venture, had chosen Doctor Maus as his movie man, and he was now seeking another medical expert like himself who was accustomed to hardships in the remote corners of the earth. Nor did it take him long to decide that Doctor Davenport was the very man he wanted.

Shortly thereafter, the three white men sailed for Africa. But tragedy came almost at the very outset. The genial Doctor Maus contracted yellow fever and succumbed almost immediately.

Although disheartened by the death of their friend, the two remaining scientists continued their research, and completed Doctor Neuman's tsetse survey. Then it was decided to take a full-size photoplay of African wild life. Their route took them more than 7,500 miles through the Belgian Congo, Angola, Rhodesia, French equatorial Africa, Uganda, the Cameroons, Nigeria, Anglo-Egyptian Sudan and Abyssinia. The explorers plowed through bush heretofore unknown to the

white man and inhabited by numerous cannibal tribes; they met with lions, tigers, leopards, boa constrictors and practically all the rest of the ferocious jungle brotherhood.



It Was a Rhino like This That Gored the Valiant Doctor Neuman to Death; Strength, Speed and Cunning Make This Beast a Dreaded Fighter

But just before the conclusion of the expedition, an incident occurred that spelled death for Doctor Neuman. It seems that the men had been making painstaking efforts to photograph the black rhinoceros, one of the most desperate of beasts when at bay or wounded. Eventually success came with the sighting of a great number of rhinos. Always the men endeavored to gain the closest range of their subjects, so Doctor Neuman fired his customary shot for the purpose of scaring away the majority of the herd. Nor was it long before he came within a stone's throw of what seemed to be two splendid specimens.

Doctor Davenport says that the point ought to be mentioned here that he and his friend always endeavored to shoot only two beasts for specimen purposes, though, of course, numerous pictures were taken of the others. Here, then, was an excellent opportunity to get both specimens and pictures. All went well for a few moments, though while Doctor Davenport was cranking his machine he was well-nigh petrified by the desperate chances his colleague took. Again and again Doctor Neuman would approach within a few feet of his quarry and then, with a well-placed shot, make it impossible for the beast to lunge at him with its razor-edged horn.

In this fashion Doctor Neuman managed to kill the two rhinos. Whereupon he turned to one side for a moment to enjoy his well-earned victory. But he had made a terrible mistake. He evidently had failed to notice the presence of a third rhino. Hidden somewhere in the bush, it now rushed at him. Doctor Neuman took careful aim and—the rest is an episode which Doctor Davenport does not like to describe, for the Brussels scientist, one of the world's best shots, had for once in his life failed to reload his rifle. Of course, the murderous rhino was soon killed by other members of the party, but the incident took away all Doctor Davenport's enthusiasm and he returned to civilization.

The explorer is often asked: "How were you able to take such remarkable 'shots' of wild animals without getting killed?" To which he smilingly replies: "By a great many maneuvers which Doctor Neuman and myself, both amateur movie men, had to work out as each new situation arose. For instance, once, in the heart of the jungle, we were somewhat hard-pressed for a fairly safe 'camera booth,' when all of a sudden right before our eyes we saw one made to order—a hollow tree. By perching here for hours, and carefully placing bait around the vicinity, we managed to persuade the great jungle animals to become regular motion-picture stars."

One of the most hazardous situations in which Doctor Davenport found himself was in the course of attempts to photo-

graph hippos out of water. Realizing that these giant animals have the habit of returning to their pool after an all-night food orgy in the papyrus swamps, the two men set up their cameras in the run through which the beasts always entered the water. Just at the crack of dawn, when there was barely sufficient light for photography, a tremendous noise broke through the silent thickets. And soon a massive animal came within scant eight yards of the lens.

Yet another "thriller" is described as follows by Doctor Davenport: "I was once treed by a wounded buffalo. As I perched among the protective branches, he pawed at the base of the tree. After five hours of waiting, darkness fell. My servants came out seeking me and were attracted by my cries. Immediately the buffalo charged them. This gave me a chance to descend and retrieve my rifle which lay a few yards away. Back came the brute after me. But this time I got him."

Doctor Davenport and Pet Chimpanzee He Captured Himself; Below, Magnificent Specimen of a Jungle Elephant Killed by Hunters

Doctor Davenport wishes to explode a few popular superstitions concerning the characteristics of well-known jungle beasts. He points out, for example, that, though the lion is regarded as the king of the jungle and possesses perhaps the highest degree of courage of all his fellows, he is not so dauntless when confronted all of a sudden with a pack of howling dogs.

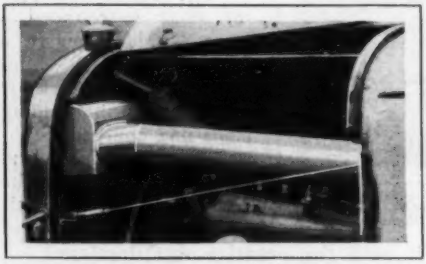
"One day a dozen of my dogs surrounded a huge Nubian lion in a dense underbrush. Suddenly the big fellow dashed from his hiding place and charged 'Stubby,' a thirty-five-pound nondescript dog. The dog never budged, although I wasn't aware of it until the negative was developed. I was watching the lion. He leaped several paces toward Stubby and then abruptly

Herd of Hippopotamus at Their Bathing Beach; While These Animals Are Not as Ferocious as the Rhinos, They Are Difficult to Approach and Photograph in Natural Settings

stopped and ignominiously backed into another brush heap. I presume that it was the first time in the jungle king's life than he had been challenged by a smaller animal, so he had retired to think matters over."

RADIATOR HEAT WARMS AUTO WITHOUT EXTRA FAN

Utilizing the hot water of the new Ford radiator and the Ford fan, a heater for these cars is on the market which requires no motor, no extra radiator and no additional fan. The equipment includes a shutter for the radiator, a housing built around the upper part of the fan, a metal tube to conduct the warm air from this housing into the car, a deflector to circulate the air inside the car, and a dash control to regulate the heat. The control manipulates the radiator shutter so that the temperature of the water or cooling solution is governed, and the shutter helps keep the radiator from freezing.



The Regular Radiator and Fan Supply Heat for the Ford with This Equipment

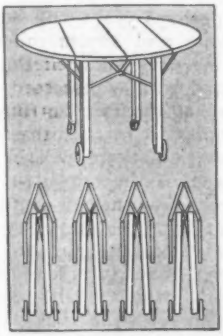
ARMY CLOCKWORK BOMB SIGHT MARVEL OF INGENUITY

A clockwork bomb-dropping sight which automatically computes the data necessary to guide an aerial bomb to its target has been developed for the army. It is described as more complicated than a chain of Swiss watches, and is to cost $28,000. It is so accurate, it is claimed, that an airplane can drop 100-pound bombs down the smokestack of a battleship, the one place where deck armor offers no protection to the engines.

FROZEN RUINS OF ANCIENT CITY FOUND IN ARCTIC WASTE

Evidence of man's prehistoric life in the Arctic has been dug out of frozen ruins of a large Eskimo settlement on St. Lawrence island in the Bering sea. This island and the Diomede islands may be called the metropolises of the prehistoric Arctic. Frozen refuse heaps revealed ivory and bone harpoons, meat picks and many delicately carved objects, possibly used as caps for ceremonial wands, charms and personal ornaments. There are no such things in the modern Eskimo household. Three successive stages of Eskimo culture are traced in the ruins, and the oldest, most deeply buried objects show the finest and most intelligent workmanship. The layer above shows articles decorated in less ornamental fashion, and the topmost layer shows craftsmanship of modern Eskimos who have lived in the past 300 years. The age of the most ancient finds was estimated roughly at 1,000 years. The finds indicate that Eskimos whom white men never met were of a higher state of culture than those of today.

COLLAPSIBLE SERVING TABLE AND TEA CART COMBINED



Folding into a nine-inch space, a collapsible round table is on the market, which may be shoved out of the way into a corner when not in use. The compact piece of furniture may be used as a serving table, accommodating five or six persons, and is fitted with rubber-tired wheels so that it may be utilized as a tea cart, or as an auxiliary table.

¶The Popular Mechanics Bureau of Information offers its free service to all readers of this magazine. Names and addresses of manufacturers and dealers in articles described, and any other details in our possession, will be promptly furnished.

Smokers in Oil Fields May Not Use Matches, So They Are Provided with Electric Lighters

ELECTRIC LIGHTERS IN OIL ZONE FOR USE OF SMOKERS

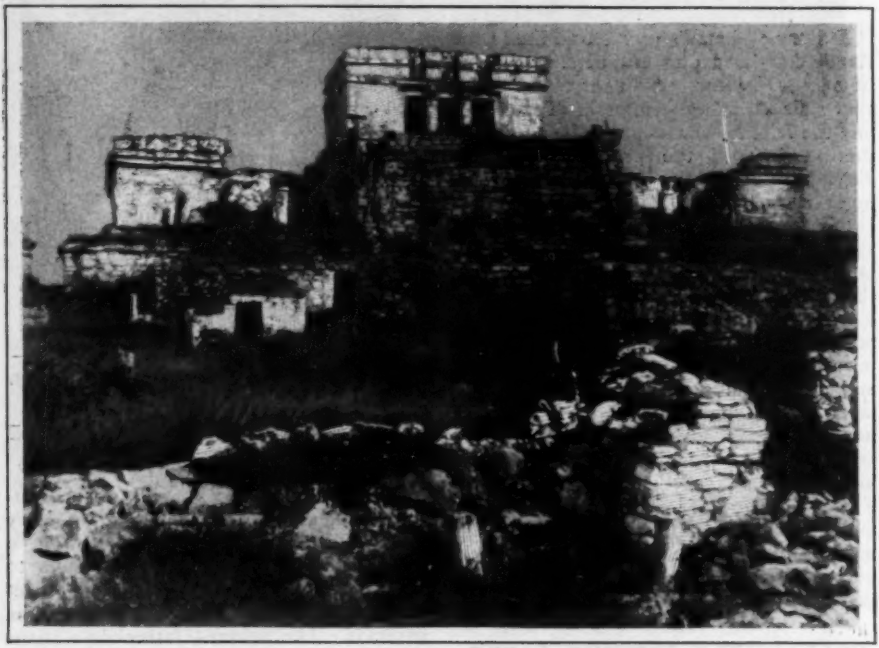
Workmen in the oil fields near Beaumont, Tex., are forbidden to carry matches, so smokers are left without a light. To make it possible for them to smoke in certain isolated sections, electric lighters have been installed on the grounds. The lighters, fastened to posts, have a protecting roof to save them from damage by the weather and the smokers from injury while using them. Smokers must be cautious, even with this safeguard.

STARTING STALLED CAR EASY WITH AUTOMATIC CONTROL

Eliminating the possibility of not being able to start the motor when the car is stalled in traffic or on a hill, a device for Fords with automatic choke control now is on the market.

It is attached to the steering wheel and operated by hand. Turning a lever to the right primes and starts the motor, and a left turn starts the motor when priming is unnecessary. The choke releases automatically when the motor starts. The control device is easily and quickly installed.

MAYA RUINS IN JUNGLE DISCOVERED BY LINDBERGH



Ruins of One of the Maya Cities Found by Colonel Lindbergh and a Party of Archæologists during Air Exploration of the Yucatan Peninsula; Land Expeditions Soon Expect to Visit Them

In discovering four ruined Maya cities dotted on the great unexplored area of the Yucatan peninsula of Mexico, the airplane flights of Colonel and Mrs. Charles Lindbergh and Carnegie Institution archæologists have given a better conception of the line of growth of the ancient Maya civilization. The newly discovered cities lie in a line stretching northeastward from the old empire region, located largely in what is now the Guatemala republic, where the civilization emerged about the time of Christ. The newly found ruins connect this older area with the new empire region, on the north end of Yucatan peninsula. Chichen-Itza is the outstanding example of this new empire culture. Flying over unmapped dense tropical jungles, the Lindbergh party sighted three ruined cities definitely determined to be "new." A fourth city, one of the largest found, may be a new discovery, but it may prove to be one seen by Dr. Thomas Gann some years ago in the vicinity of Lake Bacalar. Many months, and perhaps years, will be required to investigate and explore the cities located from the air. Many weeks of hard travel by land will be necessary to place land parties at the ruins. But when the broken temples are rescued from the enveloping vegetation, there will be available a better idea of the spread of the Maya, who more than fifteen centuries ago arose from primitive simplicity to a complex state with highly developed religion and government, and monumental architecture. How and when the center of Maya culture shifted from the old empire region to the new empire has been one of the unanswered questions. The connecting cities now found will probably supply the answer. The four discovered ruins are located in flat country. From the air, the raised temple mounds could be seen twenty miles away in some cases. But giant trees and dense vegetation rise about 150 feet to shroud the glistening white stones with which time has dealt

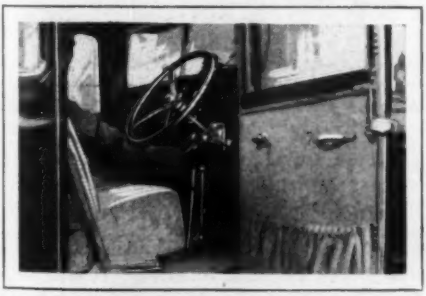
severely. Only by flying low over the area could the central temples of the cities be seen and studied from the speeding airplane. The first ruined city, seen on the first day's flight, is located in the southeast corner of the state of Campeche, some fifty miles from the Guatemalan boundary.

DIFFERENCE IN HUMAN ABILITY IS FOUND TO BE SMALL

Variation in actual ability between the brightest person and the dullest is surprisingly small when reduced to figures, Dr. David Wechsler, New York psychologist, has found. Leaving out such extremes as the genius and the idiot, it is found that the distance separating the most able individuals from the least able ones may be expressed by the ratio of two to one. The normal person with the weakest memory can remember five digits after they are repeated, while the best memory carries but eleven. The person who reacts fastest to a signal acts only a little over twice as rapidly as the slowest. It is the same with physical variations, body weight ranging from about 88.2 pounds to 209.5 pounds; the heaviest brain weighs less than twice as much as the lightest, and the greatest cranial capacity is less than twice that of the lowest.

THREE MORE GEARS GIVEN CAR BY ELECTRIC SHIFT

Addition of an electric device connected to a back-axle gear box gives a French automobile six gears in all. A control lever, placed next to the steering wheel, is used to alter the gear ratio. The car still has the usual three-speed gear box.



View of Electric Shift Which Adds Three More Gears to the Usual Three-Speed Gear Box

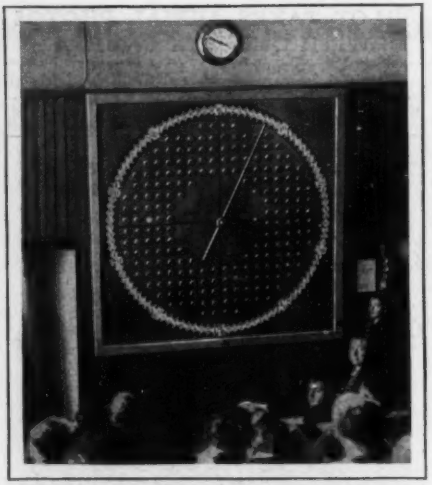
PILOT TAKES AERIAL PHOTOS WITH ONE-MAN CAMERA

With equipment developed by Lieut. George W. Goddard, of the army air corps, at Chanute field, pilots make their own aerial photographs without the assistance of another man in the plane. This is done by a special mounting for the camera at the side of the ship and a sighting arrangement attached in such a way that the pilot obtains a view of the area which he wishes to photograph simply by turning his head. He aims at the central object and, when the sight points directly at it, he presses a button on the control stick. This operates the camera and takes the picture. With this arrangement, civilian flyers can now enjoy the thrills of making aerial photographs while piloting their ships, and the invention would be useful in war time. At present, a photographing airplane is easily identified by the enemy. The one-man camera ship could be more easily camouflaged, and swifter single-seat ships could be used on picture-taking expeditions. The side opening for the camera might be completely closed when the instrument is not in use.

Courtesy Army Air Corps

Special Mounting for an Aerial Camera, Which Enables a Pilot to Snap His Own Pictures

¶The bugle call "Retreat" of the United States army is known to have been used by the Crusaders.



Wall Register for Auction Sales, Which Shows the Highest Bid and the Number of the Bidder

REGISTER SHOWS HIGHEST BID AT AUCTION SALES

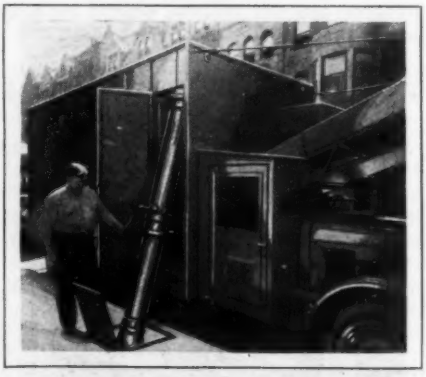
Keeping track of the highest bid at all times at auction sales is accomplished in Basle, Switzerland, with a wall register, circular in form, which has an indicator pointing to the high bid. The indicator also shows the person making the bid, as each bidder is assigned a number and the number is illuminated at the same time as the bid is indicated.

ALL DRUDGERY IS ABOLISHED IN MODEL APARTMENT

Problems that housewives have coped with since the beginning of civilization—cooking, the care of children, and cleaning—are to be studied in a laboratory in the form of a model apartment building with a central kitchen and a central nursery. The experiment, it is hoped, may result in improving the lot of the great body of housewives unable to afford domestic help. The central cooking service will supply meals fully prepared, or the housewife may market for herself and use the kitchen to prepare part or all of the meal. The kitchen will serve meals to school children if parents are away during the day, and the nursery school and kindergarten will care for the children part of the day, and in the evenings if parents wish to go out. Maid service by the hour or day, and special quarters for tenants who become ill, are other features of the experiment to be conducted under the direction of the department of home economics of Columbia University. The project is expected to relieve both husbands and wives of some of the drudgery of housekeeping, and combining the requirements of many families in one kitchen or nursery will reduce the expense.

ASH CANS IN HOME REPLACED BY PNEUMATIC TUBES

Pneumatic tubes are replacing cans for the removal of ashes from office buildings, and the system may be extended also to homes. With a minimum of labor and no diffusion of dust, the ashes are sucked through a pipe line extending from sidewalk to ash pit. The equipment includes a truck containing a large hopper into which the ashes are drawn and from which they are transferred by an inclosed belt conveyor to another truck which hauls them away. The first-mentioned truck is equipped with gas-electric drive, and power for operating the system is obtained from an electric generator and motor. Ashes equivalent to the contents of a dozen standard cans may be drawn each minute to a distance of thirty feet. The conveyor truck connects to the pipe line at the sidewalk opening. It will also function efficiently in unloading barges carrying coal or other bulk cargoes.



Ash Cans Are Being Replaced by This Truck, Which Sucks the Ashes through Pneumatic Tubes

What Airplane Markings Mean

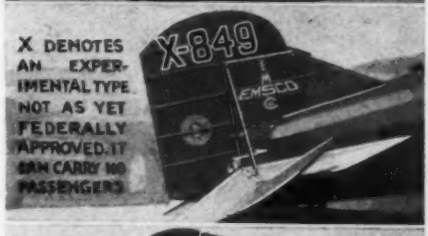
By PAUL D. PADDOCK

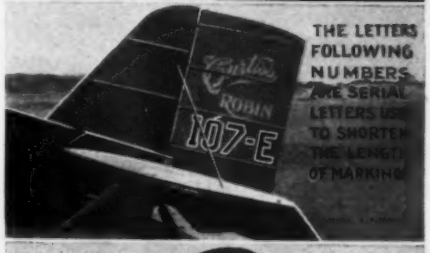
NUMBERS and letters on airplanes, balloons and airships are significant and interesting, for they reveal something of the status of the craft they identify and, if correctly understood, may be a source of guidance, protection and entertainment.

By an airplane's number, for instance, you can tell at a glance whether or not that particular ship would be allowed to fly internationally or is confined within the borders of the United States. The characters will show if the plane is merely an experimental one, not licensed to carry passengers or goods for hire, or if it is restricted to special uses only.

The appearance of certain letters in the symbol indicates that the craft has been fully licensed by the department of commerce, and therefore bears the stamp of government approval as being airworthy and fit to carry passengers under the direction of a properly licensed pilot.

The identification system, simple and easily interpreted, has been devised and is applied by the aeronautics branch of the department of commerce, and in one of the busy Washington offices, files are kept, giving records of all aircraft to which numbers have been assigned. The information obtainable here is often valuable in determining the ownership and proper status of aircraft, just as the automobile-licensing system is an aid in identifying motor cars.

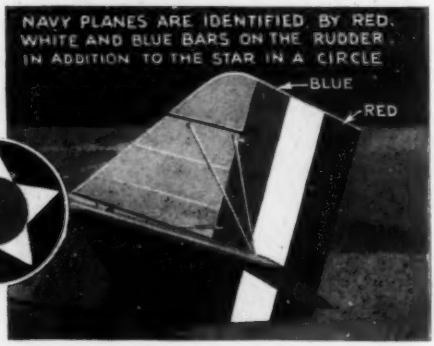


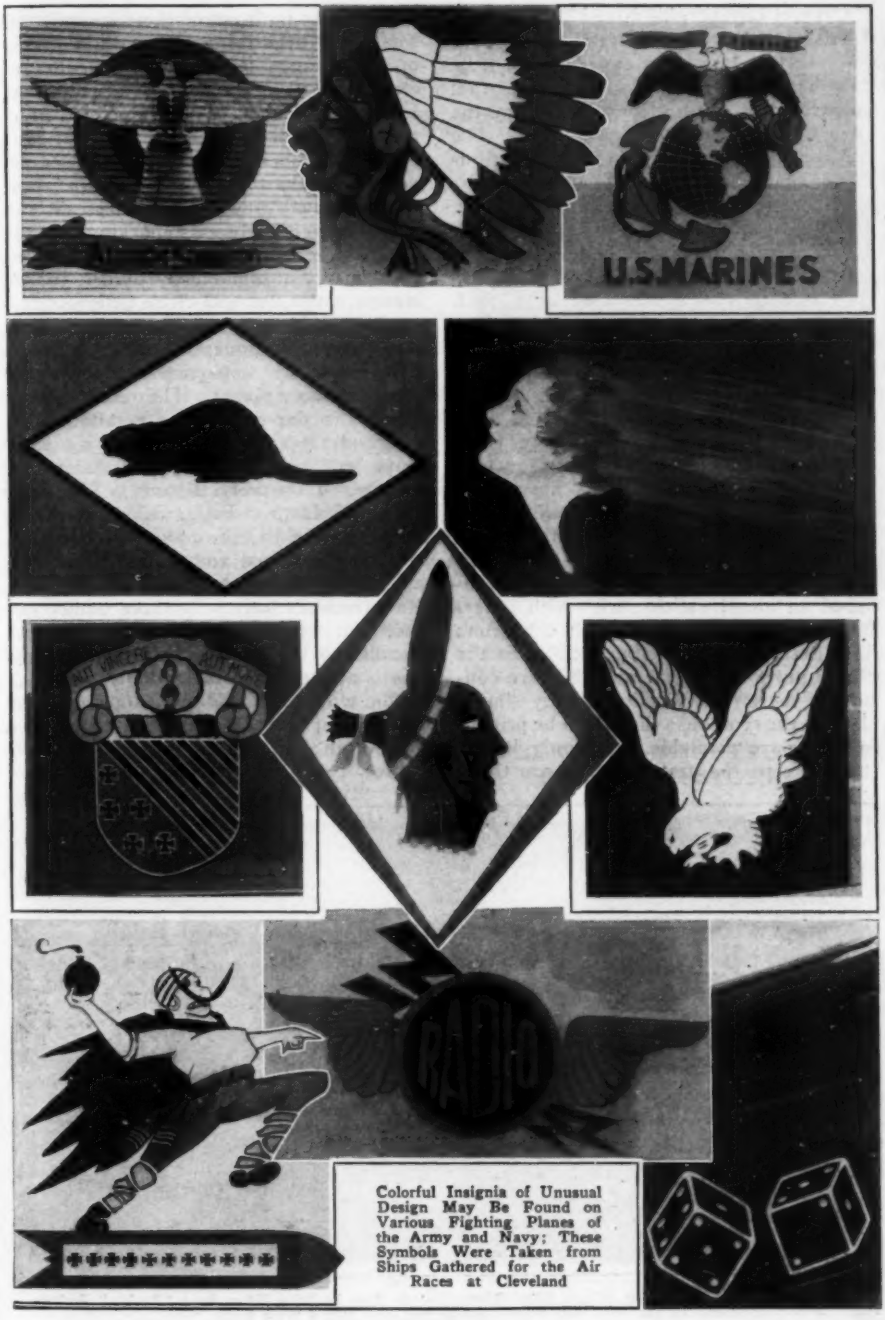


"NC" ON AN AIR PLANE MEANS THAT IT IS LICENSED FOR INTERNATIONAL OPERATIONS, AND FLYING IN U.S.
NC-706
"NR" DESIGNATES AN AIRPLANE, RESTRICTED IN ITS USE, WHICH MAY BE FLOWN OUTSIDE OF THE UNITED STATES
NR-962
"NS" SIGNIFIES AN AIRPLANE LICENSED AND OPERATED BY THE GOVERNMENT OR STATE
NS-10
THIS SYMBOL IS NO LONGER ISSUED
"NX" DENOTES AN EXPERIMENTAL MODEL NOT AS YET APPROVED, BUT PERMITTED TO FLY INTERNATIONALLY
NX-701
BLUE
RED
ARMY SHIPS ARE IDENTIFIED BY RED, WHITE AND BLUE STRIPES ON THE RUDDER, IN ADDITION TO THE STAR WITHIN A CIRCLE

There goes a plane bearing the number 7501. It appears on the under surface of the lower left wing and on the top of the upper right wing as well as on both sides of the rudder. The position is worth noting, for it has been designated by the department of commerce which specifies that airplane symbols must be displayed in that manner. In the case of a monoplane, the characters would be on the upper surface of the right wing and on the underside of the left. Numbers only indicate one of two things and both are important. A plane, so marked, is not yet licensed. The number may be the temporary identification pending the granting of a license, or it may be the mark of a ship the owner of which has not even applied for license. All aircraft need not be licensed, but all must display an identification mark when in flight. The plane with numbers only may be eligible for a license, and the pilot will have a slip showing that application has been made for the license.

When the license is issued, the letter "C" is placed before the numerals. That character, appearing in front of the number, always indicates a licensed craft and is therefore a stamp of safety for the guidance of the man who wants to fly as a passenger. "S" before the numerals, likewise indicates a licensed unit, but such a ship is used solely for governmental purposes and belongs to the "states, territories, possessions or political subdivisions thereof." "X" before the number shows that the craft is for experimental purposes only. Passengers or goods could not be carried for hire in such craft.





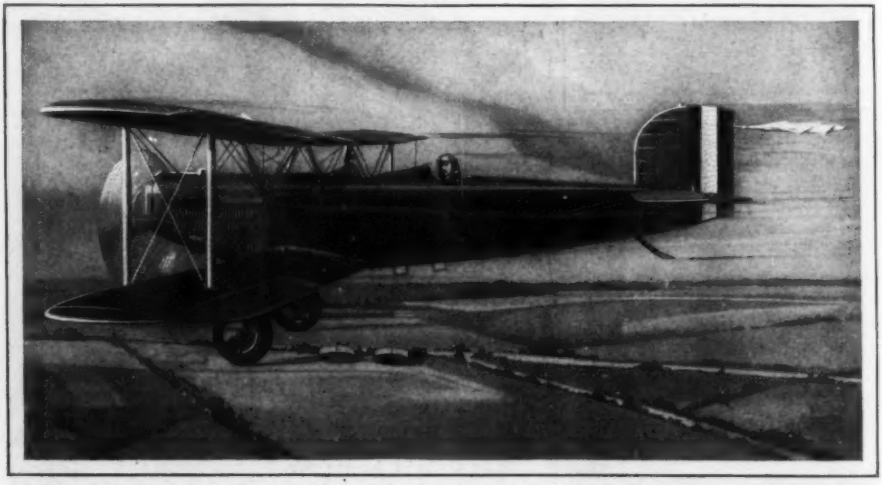
Colorful Insignia of Unusual Design May Be Found on Various Fighting Planes of the Army and Navy; These Symbols Were Taken from Ships Gathered for the Air Races at Cleveland

Colonel Lindbergh's famed "Spirit of St. Louis" is likewise universally known as "N X-211." It was an experimental ship, as it had a longer wing span, greater fuel capacity and other departures from the regularly licensed planes of that type. The "N" was Lindy's license to fly internationally. That symbol must appear on all aircraft engaged in foreign air commerce, and like the letters "X," "C" and "S," it precedes the numerals. The letter "R" before the number shows that the craft is restricted to special purposes only, such as crop dusting, photography or fire-patrol duty.

"C," "X," "N," "S," or "R" before the numerals thus clearly indicate important facts about the purpose and possibilities of the craft. Obviously, there can be combinations of the letters, such as "NS," "NC," or "NR." "NX" licenses no longer are issued. Because of the limitations of the wing surface with the consequent necessity of as few digits as possible, the department recently has established an identification series with letters following the numerals. Such characters have absolutely no significance as to the craft's purpose or functions, but are considered merely as numerals; they simply shorten the symbol so that it can be printed in the space available. The only letters that concern the craft's nature are those that appear in front of the numerals. If a plane or other aircraft is "washed out," or taken out of service for any reason, its number is never reassigned to any other. For that reason, the files of the aeronautics branch of the department of commerce contain records of many hundreds more craft than are actually in operation.

Army, navy and marine-corps aircraft have their characteristic markings as well as commercial ships. A distinguishing feature of army and navy planes, for instance, is the star-and-circle insigne. This appears on the top surface of each upper wing and the underside of each lower wing on army ships and, on the upper wings of navy planes. The red and white stripes on the rudder are parallel to the longitudinal axis of the plane on army ships, and on navy craft the stripes are parallel to the vertical axis. The army rudder is further distinguished by a blue stripe parallel to the rudder post and thirteen alternate red and white stripes parallel to the longitudinal axis of the plane. Navy rudders have only three bands, one red, one white and one blue. All are parallel to the vertical axis, and the red one is at the tail of the rudder.

The words "U. S. Navy" appear on the fuselage of navy planes together with a symbol in large characters showing the plane's type, its squadron and individual

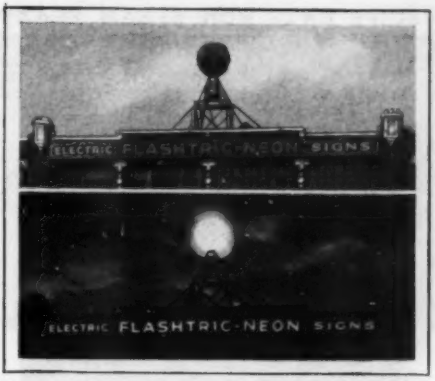


A Flag, Flying from the Rudder, Warns Other Pilots That the Ship Is Being Flown by a "Rookie," Perhaps on His First Solo Flight, and So, All Give Him a Wide Berth

number. For instance the sign "4-F-10" means the tenth plane of the fourth fighting squadron. The squadron number appears first, then the letter indicating the character of the squadron, "F" for fighting, "T" for torpedo, "O" for observation, and so on. On both sides of the fin are smaller numbers and letters, such as A-1221, for instance. That is the designating symbol of the plane for department records. It remains the same for that particular ship for record purposes, while the large symbol, showing the squadron and individual number of the plane in that squadron, may be changed according to the ship's assignment. "Z" signifies a lighter-than-air craft and appears on the dirigibles. "V" is the symbol for heavier-than-air craft.

Familiarity with the insignia of army, navy and commercial ships is a great aid to airport officials, pilots and others, and helps civilians as well. Planes and other aircraft of the army, navy and marine corps often bear, besides the letters and numerals, the interesting coats-of-arms, or other devices, that distinguish the units to which the craft belong. Wide diversity of color and design characterize these symbols. A sign that every pilot knows and heeds is neither a letter nor a number but a flag flying from the tail of the ship. It means that the pilot of such a craft is a "rookie" airman, feeling his wings, and it will be wise and helpful to give him a wide berth.

Commercial pilots often make requests for special numbers, the department of commerce reports, the preference often being for low numbers or other special characters just as automobile drivers ask for favorite numbers. The same wishes are manifest with regard to license numbers for the pilots. One of the most famous aviators in the country, "Casey" Jones, enjoys license No. 13, as he insists that it is a symbol of good luck to him.



Day and Night Views of Revolving Ball Which Attracts Attention to a Factory

LIGHTED SPHERE ON BUILDING LOOKS LIKE BALL OF FIRE

Resembling a flaming red ball in the heavens at night, a metal sphere illuminated with neon tubes is used to attract the attention of Chicago motorists to a factory beside a boulevard. The ball is five and one-half feet in diameter, mounted on a vertical shaft and revolves sixty times a minute. When the ball is lighted, it seems like a whirling sphere of fire.

BARBER SHOP MOUNTED ON VAN GOES TO CUSTOMERS

Residents of a rural section of Ohio need make no trips to the barber shop, because a barber has a shop on wheels that comes regularly to them. The traveling shop is housed in the front compartment of a truck, the rear section forming a home for the barber and his wife during their travels. The shop contains a modern chair and is supplied with both electrical current and hot water. Besides the barber shop and living quarters, the owner has provided the truck with a special compartment for his dog.

Barber Shop in Truck Which Is Also the Barber's Home and Has Shelter for the Dog

SUN'S RAYS RUN STEAM PLANT FOR USE ON FARMS

Laboratory Equipment Which Demonstrated That the Sun's Heat Can Operate a Steam Plant

Harnessing the sun's rays to operate a motor has been demonstrated by Dr. Robert H. Goddard, of the department of physics of Clark University, inventor of the interplanetary rocket. The solar motor uses the heat of the sun with a system of mirrors, water and mercury to generate steam power. Laboratory tests with a model have shown it to be practicable for use on farms and wherever sunlight is strong and dependable. Such energy may be produced at little cost.

SHAPE FIXES BULLET'S POWER INSTEAD OF VELOCITY

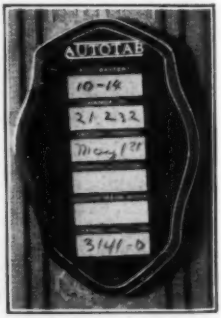
Shape, rather than velocity, is the most important factor in measuring the striking or shooting power of a bullet. Of almost equal importance, however, is the target at which the missile is fired. Big-game bullets require high velocity to get penetration, but a fast bullet fired at small game would pass through and waste most of its energy beyond the target. For this reason, a twenty-two-caliber short cartridge is more effective against small game than the long. The shocking power is a combination of the blow struck by the projectile's velocity and the displacement of tissue, due to its shape. A soft-nosed lead bullet, which mushrooms as it hits, displaces more tissue than a jacketed pellet. Standard energy tables, which give the energy or shocking power of a bullet, are not always good guides, for they are based solely on the muzzle energy multiplied by the cross-sectional area of the bullet. Tables on the accuracy of revolver and pistol ammunition place the twenty-two long rifle cartridge first.

UNIQUE MINE YIELDS SILVER, GOLD AND QUICKSILVER

Gold, silver, quicksilver, antimony and arsenic all are obtained from the same mine near Manhattan, Nev. During the World War the mine supplied antimony by the car load, and later, when arsenical solutions were demanded to fight the boll weevil, the mine supplied this product. Later it returned to the production of both gold and silver, but discovery of quicksilver ore at a depth of 1,100 feet recently resulted in the production of this metal, now widely in demand.

SERVICE-REMINDER PAD IN CAR IS HELP TO AUTOIST

Motorists are reminded when to change oil, check batteries or make other service tests by a memorandum pad which attaches to either dash or upholstery by means of two small prongs. The service reminder requires no pulling off or insertion of paper slips, the user writing on white glazed spaces beneath the various car items on which a check is kept. The marks on the glazed surface are easily erased.



Japanese Dancing Mice, Pictured Above, Have Been Found Better Sentinels in Warning Mine-Rescue Crews of the Presence of Deadly Gases Than the Canaries Which Formerly Were Used

MOUSE BETTER GAS DETECTOR THAN THE CANARY

Canaries, long recognized as dependable sentinels in warning of deadly gases in mines, particularly carbon monoxide, may lose their jobs to that odd little creature, the Japanese dancing mouse. Experiments by the United States bureau of mines indicate that the mouse is more susceptible to the influence of carbon monoxide than any of the numerous varieties of small animals or birds that have been tried. Mine-rescue crews of the future, therefore, may carry mice instead of birds into suspected underground channels. The canaries were good detectives because of their gay, blithesome nature, but the dancing mouse is even more active and restless. True to its name it appears unable to remain quiet, but runs around erratically in circles, or pivots on one foot, executing more than 400 revolutions without a stop or reversal. Then it turns, twitches, jerks and sways its head. These mice are totally deaf, are smaller than the house mouse and spotted in color. The incessant activity causes a high rate of breathing and blood circulation, resulting in keen sensitivity to carbon monoxide. The symptoms first manifested are weakness of the hind legs and slowing down of the movements. The oxygen-breathing apparatus worn by rescue crews contains only a two hours' supply, and by watching the gas sentinels, the men are able to proceed great distances into a mine without drawing on their oxygen supply, because the mice or canaries give warning of the gas long before it is present in sufficient quantities to be dangerous to human beings.

THREE THOUSAND AIRPORTS

With the completion of proposed airports, which have been listed with the department of commerce, the United States soon will have nearly 3,000 flying fields. More than half of that number are already in service. Of the latter, 445 are maintained by municipalities and 456 by commercial flying companies.

The World Seeks

By C. MORAN

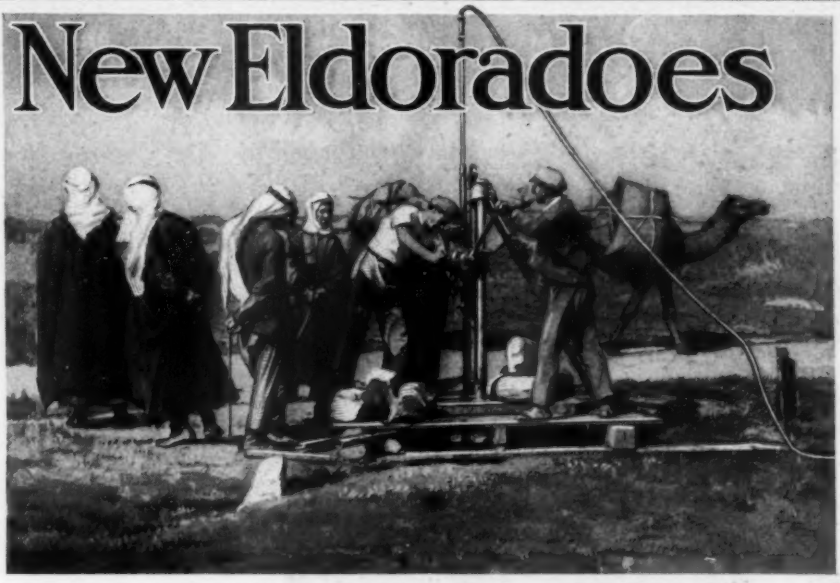
WORLD governments, confronted by steadily diminishing supplies of minerals and metals with which to satisfy future industrial needs, are searching the earth and, in some cases, the sea for new deposits of gold, silver, copper, lead, zinc and other substances. And while mining experts are seeking virgin fields in the Transvaal, South America, Mexico, China, and the Belgian Congo, scientists in government laboratories in Washington, Ottawa, London and Berlin are endeavoring to develop more efficient methods of reclaiming known low-grade ores.

Both the United States and Canada are engaged in a systematic search for new mineral and metal deposits by the use of airplanes, seismography, radioactivity, and other methods. Explorations are being made in eastern Siberia, where extensive gold-bearing gravel beds are believed to exist; in British Columbia and the Yukon, where large areas are available for placer mining, and in Australia, where once famous gold fields appear to be nearing exhaustion. Government scientists at Washington believe that the most productive results will come from developing low-cost methods of recovering low-grade ore bodies.

Recent surveys indicate that the Transvaal contains gold-bearing ore reserves of about 100,000,000 tons, but that there is also available approximately 200,000,000 tons, the profitable recovery of which de-

Government Scientist Demonstrating Electric Ore Finder like Radio Detector, and Kaffir Operating Compressed-Air Drill in African Mine

New Eldoradoes



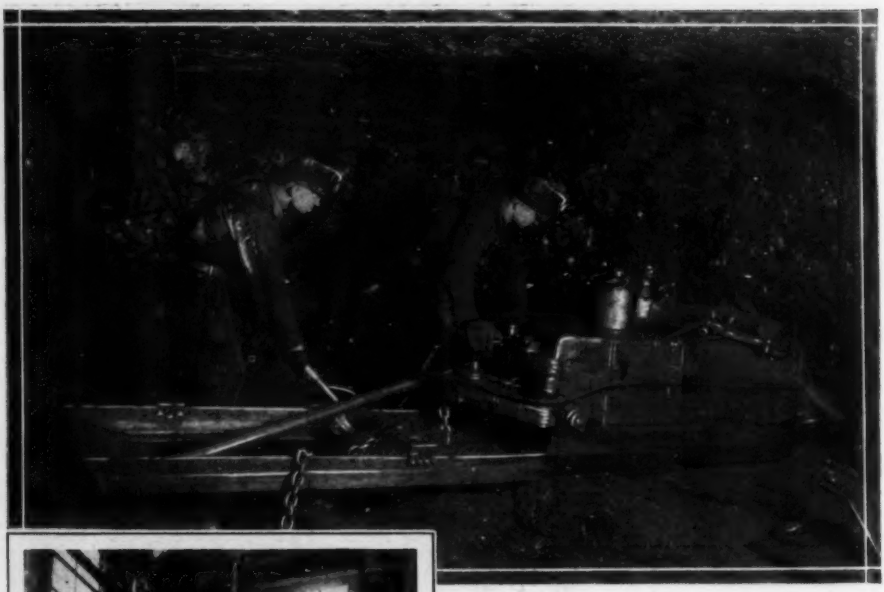
Boring for Oil in the Sahara; with Modern Inventions, the Unknown Depths Far below the Desert's Shifting Sands May Be Made to Yield Rich Finds

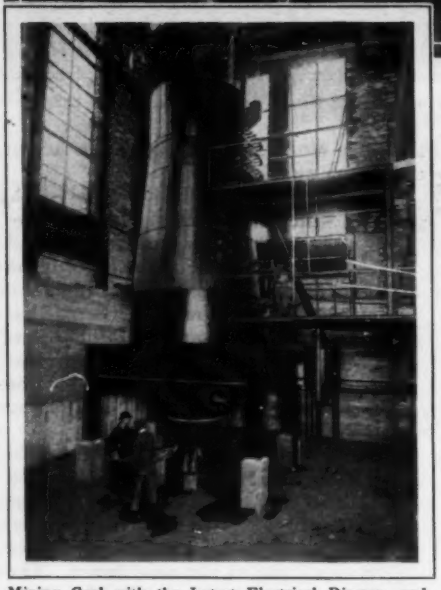
pends upon reduced mining costs. There are also large low-grade deposits in California and Nevada. The inaccessibility of extensive unexplored tracts in Central America, Mexico, China and Africa, on account of difficult topographic conditions, has now been solved by the use of airplanes. Properties are being developed in the Porcupine and Kirkland lake districts of Ontario where Canadian government officials declare that, although the gold-bearing rock is not of great width, in some places it has been followed to a depth of over 2,000 feet.

Many governmental and private explorations are being made of ocean and river beds to discover deposits under the sea, notably that of the Carnegie Institution, which has sent its non-magnetic ship "Carnegie" on a three years' cruise to obtain ocean-bottom samples and other scientific data. The ocean-bottom samples are obtained by means of a "snapper" which carries a fifty-pound weight and is lowered on a wire to the ocean floor. It goes down with jaws open; upon striking the bottom the wire goes slack, a weight releases a catch which holds the jaws open and they close, snapping up about a pint of bottom mud or ooze.

These samples contain the shells of organisms which used to live in the upper layers and which, having passed through the life cycle, have drifted to the bottom and been accumulating through the ages. When examined under the microscope, this blue, green and grayish mud opens up a new world for investigation. Most of the bottom material goes under the name of red clay, blue mud, or radiolarian and globigerina ooze.

Mineralogists declare that the world demand for metals has developed at such a rate that Europe now draws a large part of her supplies from other countries, and the United States requires practically the entire output of her own mines. The statistics reveal that more metal has been used in the last twenty-five years than in all preceding time, and that the leading industrial countries are becoming increasingly dependent upon new sources of supply. This increased consumption is the result largely of the vast expansion in the automobile, radio and electrical industries in recent years.





Mining Coal with the Latest Electrical Diggers, and Experimental Blast Furnace at the Bureau of Mines

Government officials, following a world-wide survey of mineral raw materials, declare that "students of the earth's chemistry have demonstrated that the minerals upon which present industrial civilization is based are widely and abundantly distributed, but that, from the point of view of utilization by man, the occurrences of a single mineral, or group of minerals, in sufficient size and concentration to make them commercially exploitable, are relatively few and unequally distributed throughout the world.

"Some nations have more than their share of the great mineral reserves, some conspicuously lack them, and none has a well-balanced supply of all minerals. The United States, United Kingdom, France and Germany, for example, produced more than three-fourths of the world's output of coal in the last five years; the United States, Mexico, Russia, Persia and Venezuela produced ninety per cent of the world's output of petroleum, and three economic centers—United States, Lorraine and Great Britain—produced eighty-five per cent of the world's output of iron ore. Copper is furnished from three major sources, tin from three, nickel from two. The conclusion is that the great sources of mineral supply are too few and irregularly distributed to give each nation its desired quota."

It is shown, for example, that, whereas the United States is self-sufficient in supplies of aluminum, copper, iron, lead, tungsten and zinc, the nation is dependent,

wholly or in part, upon other countries for supplies of mercury, antimony, chromite, manganese, nickel and tin. The United Kingdom is wholly or in part dependent upon other countries for all these metals, except iron; Germany and Belgium must draw on other countries for all or a part of them, and France is self-sufficient only in supplies of aluminum and iron.

Mexico now leads the world in silver production, followed by the United States and South America. Supplies in Mexico are obtained from natural deposits, but in other countries the metal is recovered from copper, lead and zinc ores, new beds of which are being sought to satisfy the world's increasing demand. Iron, on the other hand, is so plentiful that it is estimated the world steel production can be maintained for centuries to come at the present rate of over 80,000,000 tons a year.

Stripping Copper Ore in Arizona with Huge Steam Shovel That Tears the Valuable Rock from the Surface

The United States has copper reserves estimated at 1,500,000,000 tons, and large lead-zinc ore bodies of exceptional richness occur in Oklahoma, Kansas, Missouri, Idaho, Utah and Colorado. The largest known deposit of copper is in Chile, estimated at 700,000,000 tons, and large copper and lead-zinc bodies are being developed in the Belgian Congo and Rhodesia. Copper-lead mining is reported to be declining in Spain, Germany, Poland, Australia and Burma, but very rich copper-gold ore has been found recently in the Rouyn district of Quebec.

Although world supplies of practically all minerals are sufficient for many years, the various governments are looking to the time, a quarter century hence, when this situation will no longer exist. Already, the supplies of tin—a product that is indispensable as a coating in the manufacture of food containers—have dwindled to the point that known resources are regarded as inadequate to satisfy the ever-increasing demand of the industrial nations for more than ten years. More than seventy per cent of the tin now produced and consumed by industrial countries has its origin in alluvial deposits which are readily exhaustible.

In view of the certain shortage of minerals two decades hence, the United States bureau of mines is steadily increasing its researches into methods of developing low-grade ore bodies. Of especial interest are the experiments that deal with the so-called flotation process whereby the ores are finely ground, placed in vats that contain solutions of chemicals and oils, and agitated to work up a froth to which the desired mineral particles adhere while the

Apparatus for Making Liquid Oxygen, Now Used as an Explosive in Mining Operations

base supplies fall to the bottom. The bureau recently solved the problem of the application of this process to the Michigan native copper ores with the promise of substantially increasing the recovery of copper in that district at reduced production costs.

Investigation of ways of prospecting is being made by the bureau, in which the various methods—magnetic, gravitational, electric and seismic—and the principles involved are being studied in order to indicate to the mining industry how far such methods may assist in the search for new mineral deposits. Surface surveys that attempted to indicate the size and depth of known magnetite deposits have been made, and others are to be made by old and new electrical methods to verify experimentally their relative efficiency.

The stripping method of mining has been expanded rapidly in recent years in the effort to work low-grade ore at small cost. The great power shovels that are used in the stripping process range in dipper capacity from three to twelve cubic yards and weigh 125 to 850 tons. Another important recent development is the recovery of large quantities of copper by what is known as the leaching process, in which chemical solutions are introduced into large accumulations of mill tailings or rock refuse which has been discarded as of too low grade to be worked.

PICTURES OF LIGHTNING TAKEN WITH AUTOMATIC CAMERA

Accurate pictures of a flash of lightning, which lasts only an infinitesimal part of a second, now may be taken with an extremely sensitive eight-day camera known as the "klydonograph." This camera records the polarity, magnitude, steepness and direction of travel of lightning surges. A clockwork device automatically turns the roll of film and records the time of the flash. It needs no care except the weekly change of film.

SMALLEST RADIO HEADPHONE FITS INSIDE EARS

Built to fit into the ear channels, the smallest radio headphone is a part of the equipment of a flying radio plant, an airplane equipped as a laboratory to test radio sets for pilots. The shape of the phones corresponds to the shape of the inside of the ear. The plane itself has been acquired by the Bell Telephone company and will be used for the development of radio apparatus for aircraft communication, from the earliest experimental stages to the final testing of the finished product in actual flight.

Radio Headphone for Use of Pilots, So Small That It Fits inside the Ear

¶The gourd is one of the oldest of cultivated plants.

Aerial View of a Gigantic Lumber Raft in Sweden; the Raft Is Divided into Sections or "Gradation Chambers" and the Logs Are Sorted in the Various Sections According to Size

STRIKING PICTURE OF LOG RAFT IS TAKEN FROM AIR

How logs are sorted and stored is graphically shown by a remarkable aerial photograph of a raft in Sweden. The logs are floated into the numerous chambers according to size before the raft starts its journey and, as a result, when it arrives at the sawmill, its load is found in order.

GLASS SKYSCRAPERS PLANNED

A glass skyscraper, described as a "ferro-concrete structure with an outer shell of copper and glass," is being planned for New York City by Frank Lloyd Wright, internationally known architect. The glass towers make use of the cantilever principle for support of the floors, and are expected to result in a saving in construction costs. Except for the pedestals or supporting piers, the structure is fabricated entirely in the shop and assembled at the site, and while carpenters may be required to build wooden forms for the concrete, the usual building labor plays no part in construction. Four such structures are to be erected around St. Mark's of the Bonrie church, the buildings being in effect sixteen-story prisms of glass, furnished throughout in metal.

"PISTOL" SHOOTS OUT FIRES WITH FLUID CARTRIDGE

Originally intended for use on aircraft, a pistol-type fire extinguisher now is available for commercial uses. It is filled with chemicals, and a small capsule containing gas is inserted to act as the propelling force. Pressure on the trigger discharges the chemicals at the blaze, and releasing the trigger stops the stream. The chemicals will not injure metals, woodwork or fabrics. The pistol has a range of thirty-five feet and comes in quart and pint sizes.

Model of a Plane with Adjustable Wing Area; One Section of the Wing Slides into Another Section to Control Speed

ADJUSTABLE WINGS ON PLANE TO CONTROL SPEED

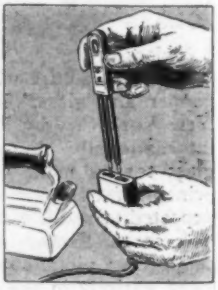
Airplane wings whose surface area can be adjusted to control the speed of the ship in the air and in landing are the invention of a California man. The area of the retractable wing is varied by sliding a part of the wing into another section of it, thus allowing a large surface with great lifting power for takeoffs and making possible landing at slow speed. When once in the air, the pilot can increase his speed by decreasing the wing surface and can also change the angle of incidence of the wing to meet varying conditions.

TELEPHONE EFFICIENCY IS CUT DOWN BY HEAT

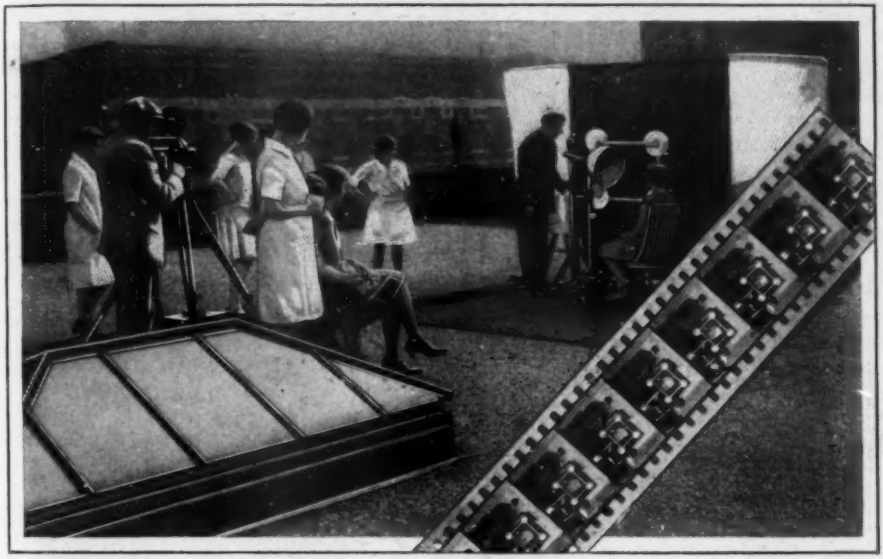
Heat adversely affects the efficiency of telephone transmission, making necessary automatic devices to control the service, particularly for long-distance conversations. A heated wire is not as good a conductor as a cold one, and while temperature changes are not particularly bothersome to a telephone circuit over short distances, the effect is apparent for cable circuits passing through sections experiencing widely varying temperatures. To offset the changing weather, a transmission regulator, in which an electric thermometer plays an important part, is used. Currents carrying the voice along the wire weaken as they travel, and so vacuum tubes are placed every fifty or 100 miles to rejuvenate circuits, the loss of power due to resistance being compensated for by the repeaters. The amount of gain or amplification of the repeaters is adjustable by means of a rotating dial similar to that on a radio set for increasing volume. Instead of making adjustments by hand, however, the changed electrical resistance of two wires is used as a thermometer to supply the information that there has been a change in temperature. The regulator causes the dial to rotate, thus increasing or decreasing the current. In the Chicago-New York cable circuit, the power received in Chicago would be 3,500 times greater on the coldest day than on the hottest, if it were not for this regulating system.

ELECTRIC TESTER LIKE A PEN FITS IN POCKET

Locating burnt-out fuses, electric-light and motor troubles, and faults in circuits for household electrical appliances, a wiring tester no larger than a fountain pen now is on the market. A tiny lamp in the top of the tester indicates trouble in the circuit when contact with the wires is made. It tests voltages from 100 to 400 in either direct or alternating current.



BEAUTY CULTURE TAUGHT WITH TALKING MOVIE



Illustrating How the Talking Movies for the Instruction of Beauty Experts and Barbers Are Made, and a Strip of the Film Used in the Lessons

Instructing students by means of talking movies is an innovation recently introduced by the Moler system of colleges to train prospective hair cutters and beauty experts. The plan marks one of the first extensive applications of the educational possibilities of the "talkies" to the trades. The film is prepared in a special laboratory and under the supervision of the colleges' leading instructors. When it is finished and edited, it is sent to the branches so that all receive the same course of lectures as is given at the parent school. In this way, special emphasis may be given to difficult points, new developments may be broadcast to all the schools and the lessons may be repeated as often as necessary.

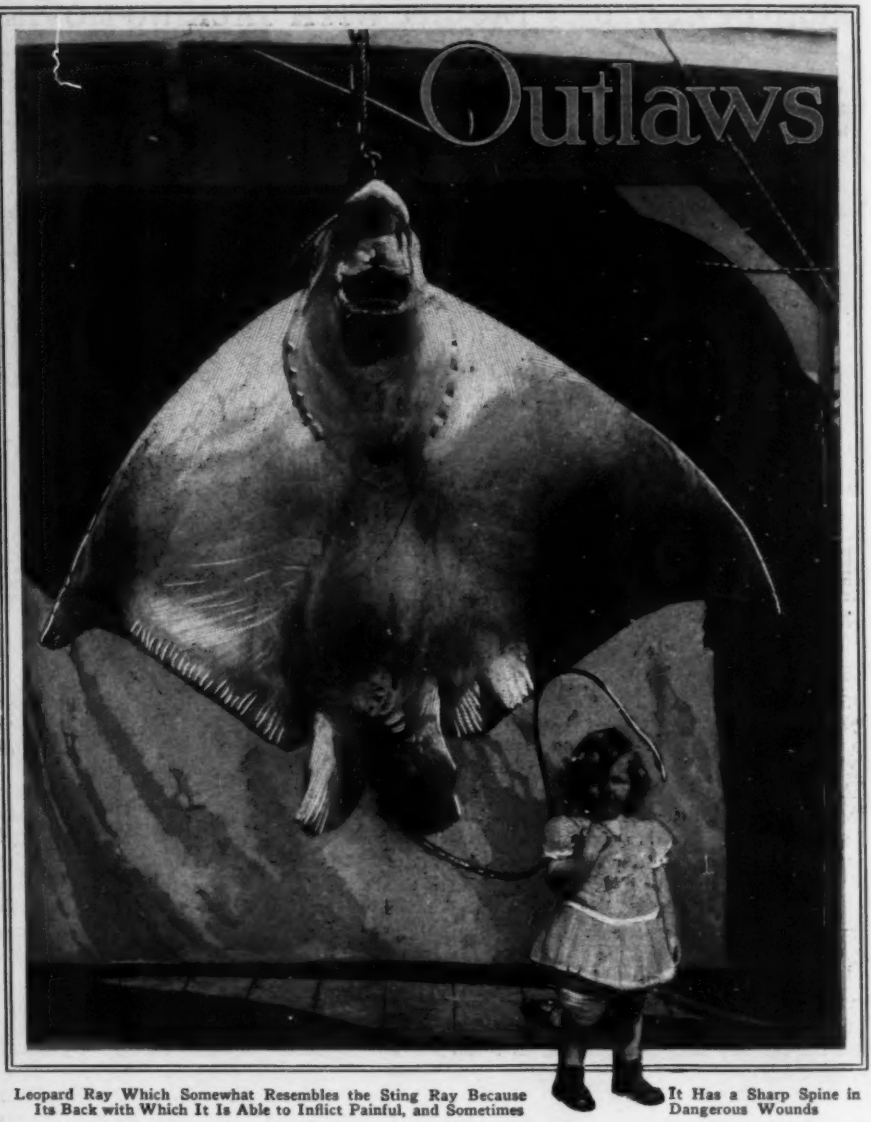
DEER FAWNS TRAVEL BY PLANE TO RESTOCK HERD

Airplanes were used in restocking the south rim of the Grand canyon with deer from the famous Kaibab herd on the north rim. Eight fawns were transported by airplane from Fredonia, Ariz., on the north side of the canyon, to Red Butte, ninety-five miles away, on the south side. They had been brought the sixteen miles from Pipe Springs to Fredonia by truck, and completed the seventeen miles from Red Butte to Grand Canyon village by the same mode of travel. Their combined air and truck journey was made in exactly three hours, whereas their predecessors of the last two or three years who made the entire trip by truck had to travel 240 miles and were from twenty-four to thirty hours on the road. The new arrivals showed no ill effects from their pioneer flight.

GLASS HALLS FOR EXPOSITION

Large numbers of comparatively small halls with walls constructed almost entirely of glass will be one of the striking features of the Stockholm exposition to be opened next May. The contents of the palaces will at all times be visible from without, and particularly in the evenings, when the halls are closed, visitors may view the exhibits from outside, as all the halls will be brilliantly illuminated. The groups of buildings are separated by flowered walks with benches for the crowds.

Outlaws



Leopard Ray Which Somewhat Resembles the Sting Ray Because Its Back with Which It Is Able to Inflict Painful, and Sometimes It Has a Sharp Spine in Dangerous Wounds

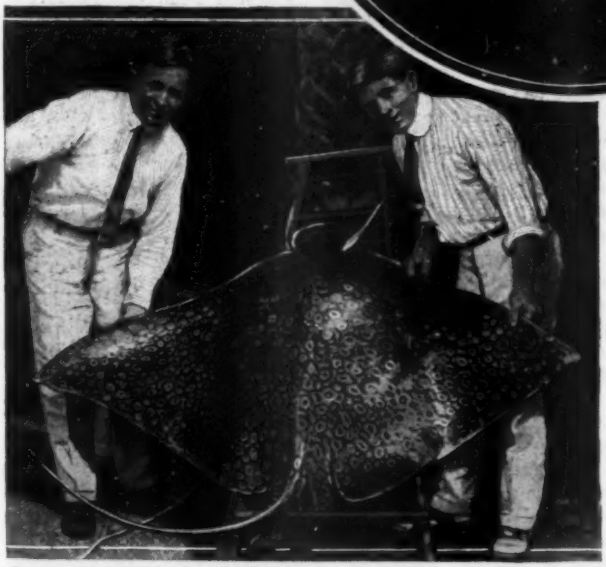
By HAMILTON M. WRIGHT

DEEP-SEA fishermen who for years have thrilled to the conquest of the sailfish and tarpon, of the gigantic tuna or horse mackerel, the swift swordfish and the barracuda, "tiger of the sea," the wahoo, and other great leaping, battling ocean game fish are now turning to larger and more dangerous quarry, the conquest of huge and vicious outlaw fish.

These outlaws of the deep embrace powerful, voracious, and generally inedible fish which do an immense destruction of

of the Sea

marketable fish. In two hours, a giant ox ray, a prodigious wing-finned monster, has been known to destroy $500 worth of fishermen's nets. Thousands of fur-bearing seals are destroyed by the savage killer whale, a big porpoiselike mammal over twenty feet long. In the brief space of thirty seconds, a leopard shark has destroyed $100 worth of nets. In ten minutes one of these sharks will destroy or maim hundreds of fish in the pound of a net, and tear the netting to shreds. Many of the outlaws possess a reptilian tenacity to life and have been known to battle for hours. Not a few fishermen have been killed, maimed or drowned while endeavoring to save their fish and nets from giant sharks and rays.



Above, Scythelike Teeth of a Man-Eating Shark That Can Shear the Bones of a Horse; Below, Leopard Ray Caught at Miami

The outlaws of the deep have not been the object of systematic pursuit. Unlike the gigantic sperm whale, and unlike the salmon in some regions, their numbers have suffered no apparent diminution. But as the market for edible fishes increases through the increase of the world's population, it is but logical that governmental fish departments should endeavor to control the destruction of these huge vermin of the deep. In this new age of the air, aviation may render magnificent service in spotting destructive fishes. How effectively airplanes or airships can be operated for this purpose is illustrated by the case of an aquarium owner. Desiring a large shark alive for his pools, he engaged an aviator who sailed over the tidal flats

Giant Manta, the "Airplane" Fish Which Leaps Great Distances; This One Weighed Over a Ton and Was Seventeen Feet Across

and in short order discovered a twelve-foot shark whose presence he made known by dipping his plane. Launches immediately put out to the spot, where the shark was speared and taken but not to its great injury. A 2,000-lb. sea cow was also taken in this fashion, under permit.

What sportsman will not cease from the pursuit of his favorite quarry when he learns a vicious and valueless marauder is in the vicinity? Here is prey larger and more formidable than lion or tiger, swifter and more tenacious of life, which can tow a launch at high speed for hours and which requires not one but many shots from a high-powered rifle before it ceases battle.

The most destructive of the great creatures of the deep to seals and large whales is the orca or killer whale. This mammal kills full-grown whales and their calves, porpoises and seals and birds, and is believed to make enormous raids upon the salmon schools. While found in greatest numbers in icy waters, it often wanders into the temperate zone and sometimes into the tropics. No other creature in the world could give the sportsman who is brave enough to tackle it greater thrills than this tremendously powerful mammal.

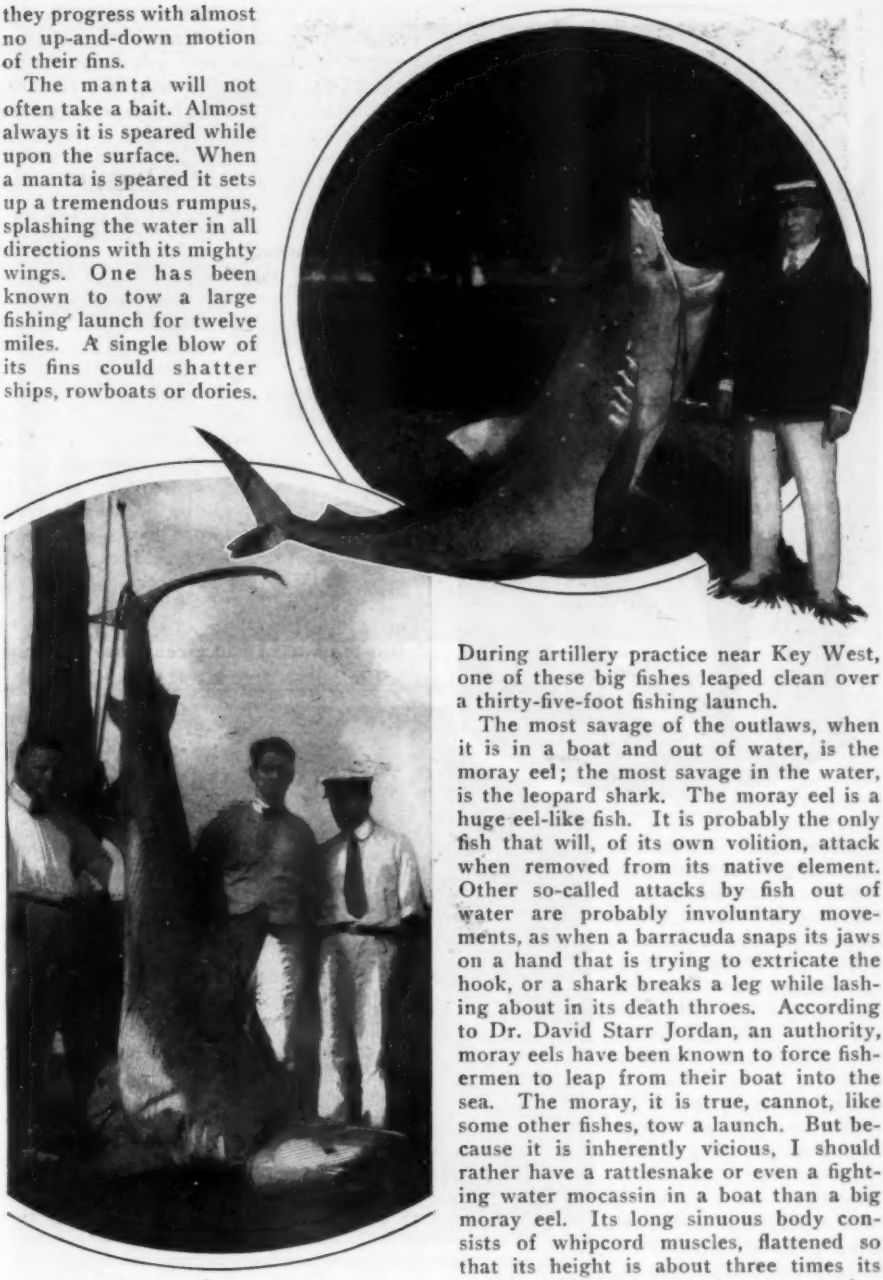
Another great outlaw is the giant ox ray. This fish weighs up to 1,800 lb., perhaps more. It reaches up to eighteen feet across its huge winglike fins. The ox ray is enormously destructive to small fish and nets. Several years ago, one of these huge creatures found its way into a net in the ocean, near St. Augustine, Fla., where it was discovered by fishermen who went out at dawn to raise their nets. The giant fish seemed so securely entangled that they approached very close. One of the men threw a spear. The huge fish demolished one of the small boats, throwing the men into the sea and seriously injuring one of them. It broke through the nets as though they had been cotton thread. The battle lasted five hours, but the huge fish could not be subdued. It was only dispatched by sending to shore for a high-powered rifle.

To the natives of the Nicaraguan and Mexican coasts, the giant ox ray, or manta, is a fabulous demon of the sea. They believe that it will leap high in the air and descend with its enormous bulk head first upon the fishing boat, shattering it and casting its occupants into the sea where it will devour them at its leisure, thrusting them down its great maw with its armlike fins, or horns. The legend is a vivid one. Once, perhaps, a leaping ox ray may have by chance demolished a frail fishing boat, giving rise to the tale. But while it is known to use its "horns" to assist it in feeding, there is little support for the idea that it would intentionally leap from the sea and crush a boat. Moreover, its throat is not large enough to swallow a man.

Although the larger rays, like the manta, and its smaller cousin, the leopard ray, which weighs up to 500 lb., perhaps more, seem to fly through the water like great bats, the motion of their winglike fins is not, in fact, so much an up-and-down motion as it is undulatory and wavelike, from front to back. Hence, from an elevation above the sea, you can see these huge sea bats flapping along through the water like heavy birds of prey, and again

they progress with almost no up-and-down motion of their fins.

The manta will not often take a bait. Almost always it is speared while upon the surface. When a manta is speared it sets up a tremendous rumpus, splashing the water in all directions with its mighty wings. One has been known to tow a large fishing launch for twelve miles. A single blow of its fins could shatter ships, rowboats or dories.



Above, White Shark Caught off Jamaica, and, Below, a Leopard Shark Landed after a Four-Hour Battle

During artillery practice near Key West, one of these big fishes leaped clean over a thirty-five-foot fishing launch.

The most savage of the outlaws, when it is in a boat and out of water, is the moray eel; the most savage in the water, is the leopard shark. The moray eel is a huge eel-like fish. It is probably the only fish that will, of its own volition, attack when removed from its native element. Other so-called attacks by fish out of water are probably involuntary movements, as when a barracuda snaps its jaws on a hand that is trying to extricate the hook, or a shark breaks a leg while lashing about in its death throes. According to Dr. David Starr Jordan, an authority, moray eels have been known to force fishermen to leap from their boat into the sea. The moray, it is true, cannot, like some other fishes, tow a launch. But because it is inherently vicious, I should rather have a rattlesnake or even a fighting water mocassin in a boat than a big moray eel. Its long sinuous body consists of whipcord muscles, flattened so that its height is about three times its breadth. When its muscles are tensed, a club will rebound from its body as from

an inflated automobile tire. The body is covered with a loose, thick and beautifully mottled skin of chocolate-brown hue, dotted with white leopard spots, merging into spotted green at the head and tail. The skin is so loose and elastic that it slips around the animal's body like an empty rubber sack.

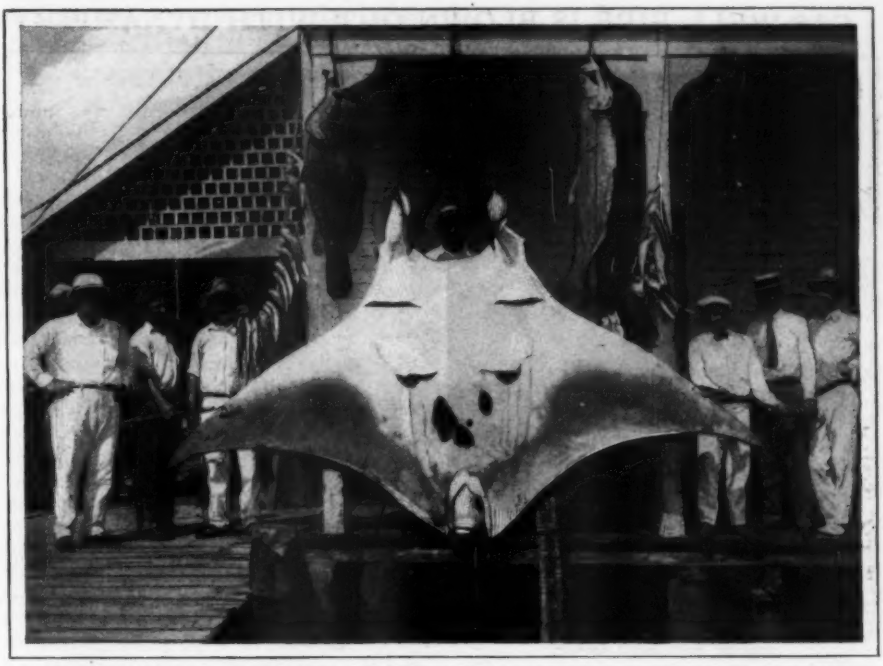
The moray eel lives among the rocks, sometimes close to shore, sometimes far at sea. I have caught them in 120 feet of water, eighteen miles from land. Living in the coral fissures and secure from attack, it reaches out to seize fish as they pass and probably actually overtakes them when hungry. Comparatively safe from the attacks of sharks or other fish, it is remarkably fearless. Its movements are sinuous like those of a snake, but it is more direct in its movements, quicker to attack, and is inherently vicious and savage. One day while fishing in deep tropical waters, I caught a huge member of the moray-eel family. It was longer than a man. Its body, at the middle, was as large as a man's thigh though flattened horizontally. At first I thought I had my line snarled in the rocks at the bottom. Then I felt the line give, and pulled up a heavy load, for I was fishing with commercial fishermen with heavy tackle. Up, up, I pulled over one hundred feet of line through the purplish waters above Gulf Stream reef. When through the greenish top water I saw what I had caught in the ocean's grab bag, I would have sworn it was an enormous python. The cruel eyes gleamed malevolently at the surface.

"Cut the line. Quick!" one of the fishermen shouted.

But too late; I had given a heave to my

© Elwin R. Sanborn

Above, Killer Whale, One of the Most Savage of Existing Mammals; Below, Moray Eels, Quick as Lightning, Vicious and Powerful



A 1,500-Pound Devilfish Recently Caught off Daytona Beach; Three Other Monsters of This Species Were Harpooned and Subdued at the Same Time, but Were Too Large to Be Brought In

fish line as the boat started up on a great wave; saw a bundle of dynamite in the form of a gigantic moray eel land on the foredeck. It made one flop seven feet up in air and in a second was between the fish well in the middle of the foredeck and the cockpit railing.

While the moray is a bad boat companion, for real danger it is, in my opinion, not to be compared with those two most savage fish found along the American coast—the leopard shark and white shark. The swift mackerel shark whose swallow tail and form suggest the mackerel, but which gets its name from its raids on the mackerel schools, is a close second. The great hammerhead shark comes third. The white shark, or carcharodon, is not often seen near the American coast.

Big sharks cannot be caught successfully from small rowboats. To have the breaks in your favor, you must have a big launch whose engine will pull against the shark. The writer almost lost his life three years ago while attempting to take a shark in a small boat. I had placed a five-pound grouper on a shark hook and anchored three-fourths of a mile out from shore along the Florida keys. The tide had started to run out and I knew Mr. Shark would soon be coming from his hunting in the shoals. Sure enough one did and started dragging the anchor, boat and all. The line fouled the bow of the boat, which turned to take in almost a barrel of water. I cleared the line which threatened to swamp the boat. Suddenly the line snapped! And a thwart to which the shark line was tied parted. If the line and thwart had held, I would have been spilled into a tide running out toward Africa.

In any event, big-game sportsmen of the future will find in the ocean more thrilling and dangerous sport than any ever enjoyed on the land. The climax in fighting the great animals of the sea is prolonged and not speedily over. Long after the lion, elephant, or rhinoceros have been relegated to public parks, the killer whales, the rays and sharks in incalculable numbers will still tempt the adventurous.

GAS-WELL FIRE IS BLOWN OUT WITH DYNAMITE

Two Views of a 75,000,000-Cubic-Foot Gas-Well Fire in the Oklahoma City Field; Two Brothers Set Off 200 Quarts of Gelatin Dynamite at the Mouth of the Hole to Put It Out

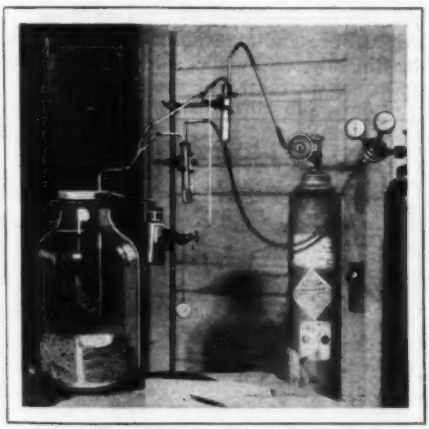
Disastrous gas-well fires, more perilous and rarer than the better known oil-well fire, are being attacked successfully with dynamite. The most recent serious gas-well fire was in the Oklahoma City field, when a 75,000,000-cubic-foot well blazed up. The gusher ran wild and became a soaring torch that could be seen for miles, reducing the steel derrick to a mass of molten metal. Two brothers, M. M. and F. T. Kinley, who make fighting oil fires a business, were summoned, and they, attired in asbestos clothing to withstand the heat, spent an entire day cutting away the wrecked derrick with acetylene torches while steam from seventeen boilers was played on the fire. When the 120-foot mass of steel had been dragged away, the brothers, behind a sheet-metal barrier, proceeded to the hole and placed a charge of gelatin dynamite containing nearly 200 quarts, enough to demolish a city block. This was set off electrically, the explosion creating a vacuum between the gas flow and the flames, thus snuffing out the fire for lack of oxygen. To prevent re-ignition before the hole could be capped, steam was played on the well while the brothers again approached and plugged it. The well burned for more than three days, but the flames did not approach within eight or ten feet of the ground because of the enormous pressure of the gas as it emerged. The huge charge of dynamite was packed into a compact bomb and wheeled as near to the center of the flames as possible.

STEEL PLUG FOR LEAKY BOILER HAS CHISEL POINT

Repairing leaks in the hot-water boiler is made easier with a plug now available. The point is wedge-shaped and a blow with a hammer forces it into the leak. Back of the point, the plug is threaded and fitted with a rubber washer so that a few turns of the wrench suffice to make the tank water-tight.

ARTIFICIAL AIR SUPPORTS LIFE BETTER THAN NORMAL AIR

That artificial air supports life in white mice and other small animals better than the ordinary atmosphere has been found, after extensive experiments, by Dr. J. Willard Hershey, of McPherson College. He also found that oxygen, the life-giving gas of the normal air, if administered to small animals in pure form, will kill like poison gas because it ruptures the lung tissues and promotes the growth of certain organisms. The normal air is composed of twenty-one per cent oxygen, seventy-eight per cent nitrogen and one per cent of carbon dioxide and the rare gases argon, neon, helium, krypton and xenon. From the list of rare gases Doctor Hershey prepared an atmosphere that supported life and also found that without the rare gases life could not exist. He mixed an atmosphere of oxygen and helium, and one of oxygen and argon, in certain proportions which supported life in a few cases even better than ordinary air. He substituted some inert gas for the seventy-eight parts of nitrogen, using the ordinary amount of oxygen. When helium was used, the white mice apparently fared better, but when argon was substituted for helium, the mice could not live as well. Doctor Hershey said he believed the widest field of prepared atmospheres will be in pathological applications, though it may also find other uses.



A Cat Being Kept Alive in an Artificial Atmosphere Composed of Oxygen and Helium

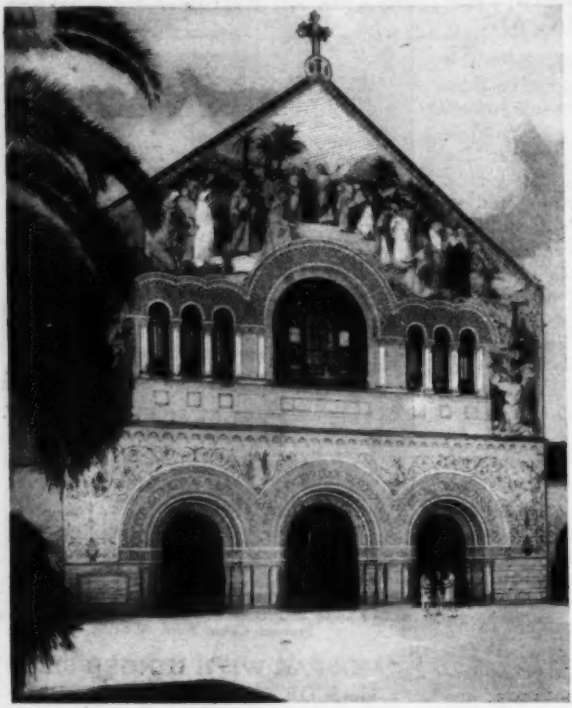
A Pan with Hinged Sides and Detachable Bottom, to Prevent Cakes from Sticking

CAKE PAN WITH HINGED SIDES HAS DETACHABLE BOTTOM

To prevent cakes from sticking, a tin with hinged sides and detachable bottom has been invented by a London housewife. The sides unfasten and are bent back on a hinge, allowing the bottom to be removed and the cake to be taken from the pan easily without breaking it.

PREVENTING YELLOW LEAVES

Application of copperas or sulphate of iron around trees whose green leaves turn yellow during the spring or summer has been found an efficient remedy for correcting the condition. For a tree six inches in diameter, a pound of sulphate of iron should be dissolved in two gallons of water and the solution poured around the tree, three feet or more from its base, after which the ground should be soaked with water. The roots absorb the mixture which supplies the lack of chlorophyll and counteracts any alkaline condition of the soil. Larger trees require proportionately greater applications.



Beautiful Mosaic on Facade of Church at Leland Stanford University; It Represents the Sermon on the Mount

HUGE MOSAIC OF BIBLE STORY TAKES YEARS TO FINISH

One of the most beautiful pieces of mosaic work in the world is inlaid on the facade of the memorial church of the Leland Stanford University at Palo Alto, Calif. The mosaic represents the sermon on the mount in full colors and is set against a background of gold tile. Tile and workmen were imported from Italy for the task by the university, which is President Hoover's alma mater. The work required many years.

BLIND DON'T HEAR BETTER BUT LISTEN HARDER

Blind persons do not hear better than those of ordinary vision, but they listen harder, investigators of the National Society for the Prevention of Blindness have found. Contrary to popular belief, blind persons do not possess greater acuity of other senses as a compensation for the loss of sight, but experience and specialization on their part enable them to develop other senses more highly than the seeing person, so that these other senses, particularly hearing and touch, serve them for some of the purposes for which normal people depend on sight. The same thing applies to deaf persons who appear to have a keener sense of vision than the ordinary individual. Such persons must rely more on sight, so develop it more.

FINS AND FLIPPERS TO PREVENT AIR ACCIDENTS

Stabilizers that help to make airplanes "foolproof" are the invention of a Californian and have recently undergone successful tests. Vertical fins under the upper wings, and flippers in front of the lower wings of a biplane are connected to the control stick in the cockpit, the fins and flippers moving with the stick. Fore-and-aft stability is maintained by the flippers, while sideslips and tailspins are prevented by the fins.

Fins on Upper Wings and Flippers on the Lower Help to Maintain Stability of This Plane

"Talkie" to Replace Phone Girls

Demonstrating Delayed Speech, through Which the Words Are Stored Up and Delivered after the Speaker Has Finished Talking

NEXT spring when telephone operators at the long-distance boards in New Jersey coast-resort towns plug in to take their New York calls, the "voice with a smile" that says "four-one-three-six-J" will not be a voice at all, but just a machine, hidden in a room in downtown New York and repeating numbers and letters to itself all day long—and all night, too.

Instead of a living, breathing telephone operator, the voice will come from either a phonograph record or a piece of film—the engineers haven't decided just which as yet, so they have built both, and made them work.

That's just one of the things about to emerge from the vast labyrinth, where the bulk of the 4,000 scientists and workmen of the Bell Telephone laboratories do their work. While one group recently was completing the mechanical voice, another group, headed by Dr. G. W. Elmen, laid down their slide rules and announced they had just calculated they could build a telephone cable under the Atlantic from America to England, though the longest telephone cable built so far stretches a bare hundred miles from Key West to Cuba. And, though not a foot of experimental cable had been built, the American Telephone and Telegraph company announced, on the strength of the slide-rule calculations, that it would proceed at once to spend $10,000,000 on the phone cable to London. Such is the confidence held in the scientists of the Bell laboratories that it was not considered necessary to build even a test piece of cable before investing that huge sum in the undertaking.

In another room, Dr. S. P. Grace has learned to talk backward—not to say words backward as they would be spelled if inverted, but to say them so they will sound right when reversed, which is an entirely different thing. His development of inverted speech is just an incident in the work on a speech-inversion apparatus that has produced an entirely new language which some day may be used to put telephone conversations into a secret code, particularly transatlantic radiophone talk, and then automatically reverse it into understandable words at the other end.

The same scientist has learned to talk into a spiral spring which stores up his words and delivers them later, after he is finished talking. A little spring stretched across an auditorium stage can delay delivery for an entire second, so that words

he speaks into the telephone reach the loud speaker twenty feet or so away a second later, while the same words sent out by radio would travel 186 000 miles in the same time. The speech-inversion apparatus, with which he has become so adept he can talk backward and have his words come out of the loud speaker right end foremost, is one of the most interesting oddities science has developed in years. The theory itself is simple, but the machinery required is complicated. The inverting apparatus acts somewhat like a camera lens in inverting an image. Instead of a glass lens, a 3,000-cycle modulating current is used to invert the electrical impulse produced by sound.

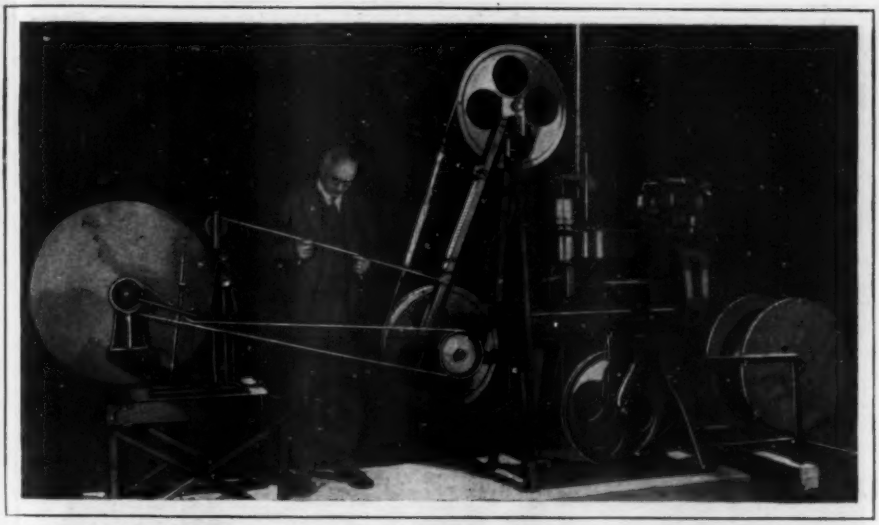
The result is that sounds of low frequency are changed to high-frequency impulses, and high-pitched sounds to low frequencies. As normal speech has a range of 100 to 2,900 cycles, and the inverting current has 3,000 cycles, the inverted speech also has a 100 to 2,900-cycle range, but in just the opposite order. In other words, a pure tone of the pitch of middle "C" on the piano, which has a frequency of 256 cycles per second, comes out of the inverting apparatus at 2,744 cycles, or 3,000, less the original 256. Consequently the voice of a person talking in a low tone comes out when inverted as a high-pitched squeak, with an occasional low-pitched grunt to represent the overtones of the original speech wave.

Listening to inverted speech the first time, nothing is intelligible. It is as strange as Russian or Chinese, or any other language foreign to the listener. It is possible, however, to learn to speak it by listening first to the normal word and then the inverted one, and this is what Doctor Grace has done, until he has become so adept that he can talk in inverted speech. The inverted words, however, present letter combinations so unusual that it is practically impossible to pronounce them, and to acquire inverted English as a language, such as Esperanto, a vocabulary would have to be adopted which would avoid the impossible words. "Illinois Telephone Association," for example, when inverted, sounds like "Oyaneon Playafiend Acecilofin."

The inverted speech is readily reversed into normal English in several ways. In one, a microphone can be placed in front of the loud speaker of the inverting apparatus, and the reversed speech picked up and transmitted back through another inverter. In another, phonograph records of the inverted speech can be made, and later, with an electrical pick-up, played back through the inverter again, to come out in their original form.

Inverted Speech on a Phonograph Record Being Picked Up by a Microphone and Reconverted into Intelligible Conversation

The development of the mechanical telephone girl is the solution of a problem



Equipment of Bell Telephone Company's Magnetic Materials Laboratory, Where Tests Have Been Conducted That Convinced Engineers of the Practicability of a Transatlantic Telephone Cable

that has bothered telephone engineers since the dial phones came into general use. The dial impulses, which operate the number selectors, employ direct current, while voice impulses are alternating currents. In ordinary land wires, it is possible to shunt the dial impulses, through condensers and around the relay apparatus and tubes which, at regular intervals, step up the voice impulses to maintain their volume. But where undersea cables are used, as from New York across the bay and down to the New Jersey coast resorts, trouble has always been experienced in transmitting dial signals.

With the new mechanical voice, the long-distance operator in New York will write the number on an apparatus with keys like an adding machine. It will have fourteen keys, numbering from zero to nine, and four carrying letters. The machine in turn will transmit the signals to the mechanical voice, which will ring the distant operator, and, when she answers, repeat the number audibly to her. If she fails to hear it, she can press a repeat key, and the voice will keep on repeating the same number until she gets it.

If the distant operator is busy, the machine will store up the calls, and give them to her, one at a time, when she gets time to answer her signal. Two types of apparatus have been developed. One somewhat resembles the picture-transmitting machines already in use on the telephone lines. A film with the ten numbers and four letters recorded on it, in the same manner as the "talkies" record speech for the movies, is bent in a cylinder around a photoelectric cell, and a beam of light played on the cell, through the film, which revolves to bring each desired number or letter into focus.

In the other system, which is the one that probably will be developed for use, the numbers and letters are recorded on a disk phonograph record, only, instead of the usual spiral groove, each number and letter will have a separate circular path. Owing to the size of the record and the limited number of concentric circles needed, it is possible to record twenty circles for each of the fourteen characters, and each circle repeats its number or letter twice in each revolution of the disk.

With this arrangement, a maintenance attendant can come around every twelve hours and move the fourteen needles into new channels, so, with twenty channels for each character, each record will last ten days, when it can be discarded and a new record installed. The film method eliminates replacements, for the film should last for years, but the energy ob-

Side View of Sending Apparatus, Which Constitutes the Mechanical Telephone Operator; Except for the Photoelectric Cell at Left, It Is Similar to Ordinary Television Equipment

tained from the photoelectric cell is so small that considerable amplification is required, while the energy from the phonograph is sufficiently great to offset the cost of a new record every ten days.

As for the new transatlantic telephone cable, which it is planned to have in operation within two years, research of metallurgical and electrical engineers combined to make it possible. Several years ago the engineers discovered that certain alloys of iron and other metals had unusual magnetic properties, including high permeability. These alloys were named permalloys, and one of them was used to make possible a new high-speed telegraph cable laid under the Atlantic two or three years ago. The permalloy is not used as the signal conductor, but as a wrapping around the latter, and has the effect of demagnetizing the conductor so rapidly that signals may be sent much faster, as the time lag between them is reduced.

The Bell engineers next discovered that cobalt had a curious effect on one of the permalloys, producing unusual constancy in permeability, without lessening the latter. Experiments were carried out with all the possible combinations of iron, nickel and cobalt, in ten-per-cent variations of the mixture, and finally an alloy of forty-five per cent nickel, twenty-five per cent cobalt and thirty per cent iron proved the best of the lot. The new materials were named perminvars, a combination of the first part of permeability and the first part of invariable, to indicate their constancy. The peculiar magnetic property of the alloy is developed by heat treating.

The undersea phone cable also calls for an arrangement that will allow talking in one direction only, but the voices of the talkers will automatically operate the switching mechanism, so that neither will be aware of the limitation, nor will there be any delays when one stops speaking and the other begins.

¶As solid a vegetable as a potato contains seventy-eight per cent of water.

FILM FOR COLOR SNAPSHOTS

Making it possible for the amateur photographer to take snapshots in color, a special film recently has appeared on the British market. Rolls are loaded in the camera in the usual manner, but an exposure twice as long as for ordinary film is required. The finished article is an enlarged print which reproduces quite faithfully the original colors. The film consists of three thin transparent layers, one being sensitive to blue light, another to red, and the third to green. They are separated for development, then superimposed prints from the three negatives are made on one paper. Cut films and glass plates for professional use also are being made.

BODY JOINED IN RADIO CIRCUIT SO DEAF CAN HEAR

Making the human body a part of a radio circuit, thus setting up mechanical vibrations in the bony parts of the skull, is the principle behind a Swiss invention that aids deaf persons to hear, provided the nervous centers of the ears are intact. A tube receiver with moderate loudspeaker energy has been found sufficient.

Radio Receiver Which Helps Deaf Persons to Hear by Making the Body Part of the Circuit

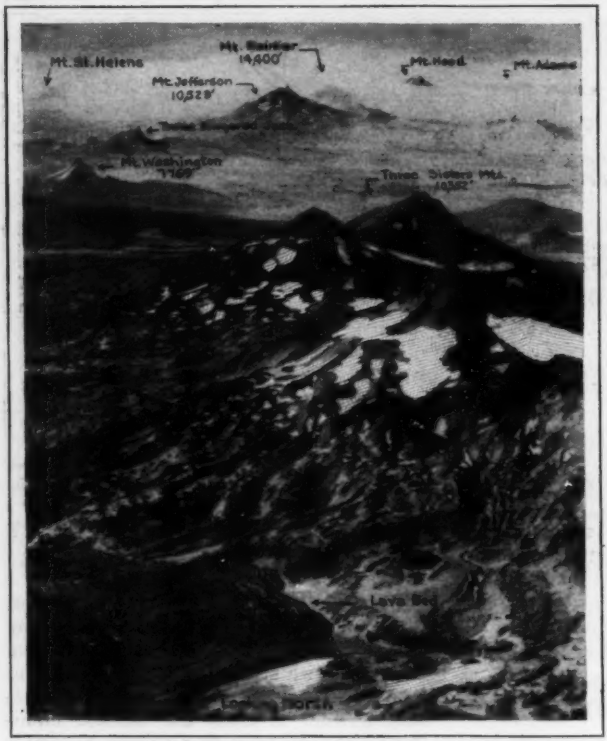
Extinguishing a Fire with Powder under Pressure; This Method Eliminates Danger of Damage by Water or Chemicals

FIGHTING FIRES WITH POWDER INSTEAD OF LIQUIDS

Fire hose that shoot powder instead of water or chemicals at a blaze are being tested in Germany with a fire engine equipped with a pump to force the powder through the hose. A harmless carbonic-acid powder is used, the method eliminating the damage to property by water and chemicals which often amounts to more than that done by the fire itself. The powder, it is claimed, does no harm whatever to anything with which it comes in contact.

WALL BUILT OF PAGAN STATUES

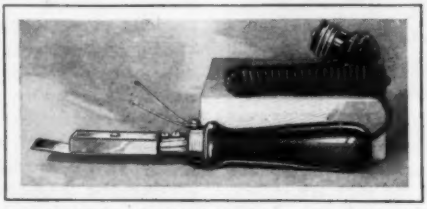
German archæologists excavating in the Rhine country, near the town of Alzey, have unearthed the foundation of a wall constructed almost entirely of sculptured stones of the imperial Roman period. The stones consisted mostly of fragments of ancient pagan shrines and temples, indicating that it was the work of builders who not only disbelieved in the old gods, but were actually hostile and wished to show contempt for them. Deities of the Roman pantheon and local gods of the early Celtic period were intermingled among the fragments of the wall, which formed part of the building that was about sixteen yards square.



Aerial View of Mt. Rainier Taken 227 Miles Away; the Camera Showed Mountains Far Beyond the Distance the Eyes Could See

AERIAL PICTURE OF MOUNTAIN TWO HUNDRED MILES AWAY

From a distance of 227 miles, an aerial photograph of Mount Rainier has been made by Capt. A. W. Stevens of the army air corps, who has reported technical results of the experiment to the Eastman Kodak company. The picture of Mount Rainier, in the state of Washington, was made from well south of the center of the state of Oregon, and exceeded by more than fifty miles the previous record for long-range photography. The photograph clearly showed mountains far beyond the distance the eye can see, even on clear days. It was taken on a film sensitive to the invisible infra-red rays that penetrate smoke and haze. Mount Rainier appears lower than closer mountains of less height because of the earth's curvature. Since he could not see his objective, Captain Stevens was obliged to point his camera in the general direction of the peak and trust to luck. The picture was made in a plane at an altitude of 17,000 feet. It is believed the picture may yield important measurements relating to curvature of light rays around the earth's surface, and eventually it is thought the mountain can be photographed from an even greater distance, as heavy forest fires increased the haze when the long-distance picture was made. Captain Stevens also has made a picture from an altitude of 37,854 feet, higher than a camera had ever been used before. Because of the haze between the plane and the earth, he had to use infra-red-sensitive film also in this case.



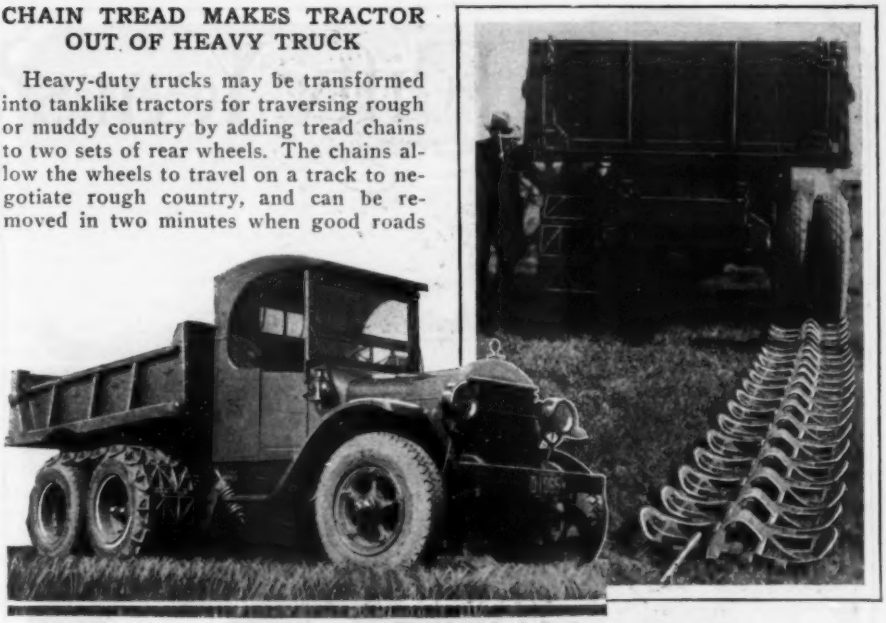
An Electrically Heated Knife Used with Shellac for Patching Dents and Holes in Furniture

ELECTRICALLY HEATED KNIFE TO REPAIR FURNITURE

For patching dents, worm and nail holes in furniture, an electrically heated knife uses shellac sticks of colors to make a patch that blends with the finish of the piece. The knife has a rest on the back, enabling the workman to lay it aside without danger of fire, and a safety catch to prevent the cord from tearing loose.

CHAIN TREAD MAKES TRACTOR OUT OF HEAVY TRUCK

Heavy-duty trucks may be transformed into tanklike tractors for traversing rough or muddy country by adding tread chains to two sets of rear wheels. The chains allow the wheels to travel on a track to negotiate rough country, and can be removed in two minutes when good roads are reached. The equipment has undergone tests by the United States army.



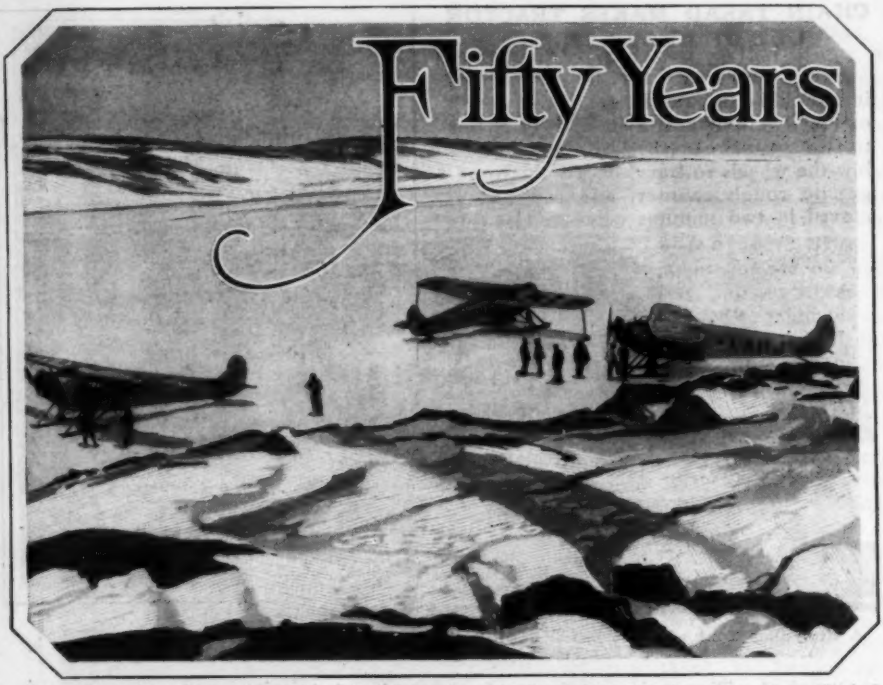
A Heavy-Duty Truck with Two Sets of Rear Wheels Transformed into a Tractor for Rough Traveling by Adding Chain Treads, Allowing the Wheels to Travel on a Track

SOUND WAVES TO LOCATE SUBS NOT YET INFALLIBLE

No sure means of locating submerged submarines has yet been developed, although various types of listening gear have proved moderately effective. Statements recently have been made, however, that the British admiralty has developed apparatus for locating submarines at a distance. Such a device, if perfected, would mean the end of undersea fighting craft, but the range of listening gear used in all the navies of the world, so far as is known, is measured in hundreds of yards, rather than miles, so that, unless the sea were alive with scout boats, many submarines would escape detection. Most of the sub locaters depend on the propagation through the water of beams of sound waves too short to be audible to the human ear and differing from audible sound waves in that they can be directed along a comparatively narrow path and can be produced from electrically excited crystals of quartz, similar to those used in radio. They reflect as echoes from solid objects and part of the echoes are picked up by the listening gear, amplified, and interpreted by observers.

PENCIL HOLDS ROLL OF PAPER FOR MEMORANDA

Searching through pockets for a slip of paper to jot down a memorandum is unnecessary with a pencil now on the market, which contains a roll of note paper inside the barrel. By turning a knurled knob on the eraser end, the paper roll may be turned forward or backward, the edge protruding through an opening in the side.



Three Ships of the Hudson Strait Ice Patrol Gathered on the Ice at Wakeham Bay; from Three Flying Bases, the Patrol Surveyed the Strait for an Entire Year

PART II

"I HAVE just returned," remarked the mining-syndicate scout at Sioux Lookout, in the bush of northern Ontario, "from a three months' trip."

"That so?"

"Yes, I started this morning after breakfast and got back in time for tea."

Impossible? Not at all. Last year, or the year before, or any other year since the white man first came to the north country, it would have taken three months or more of back-breaking labor, paddling up nameless rivers and across unknown lakes, portaging food and camp over rocky divides, after first hacking a road through the matted underbrush of the bushland, to go the places he had been.

But he didn't go by canoe with Indian guides and paddlers.

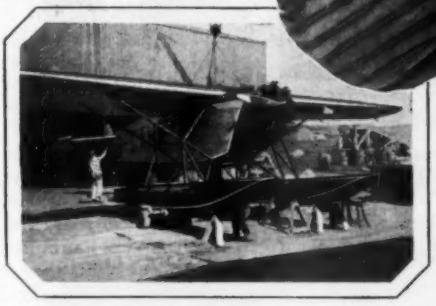
Instead he phoned the hangar out on the lake shore and ordered a plane to be ready after breakfast. He took off seated in a deep-cushioned chair in a comfortable closed cabin, soared up into the sky and droned along far above the trackless bush, and, incidentally, far above the land of flies, that terror of the north country, a generic name for pests that range from countless billions of mosquitoes to ordinary house flies gone wild and turned into man-eaters.

For every hour he flew, he traveled the equivalent of three weeks to a month by canoe. He stopped frequently to inspect claims, which cut down his total saving, for if he had flown steadily from breakfast to tea time he would have accomplished not a three months' journey, but one of about seven, and a seven months' journey is more than a man can do by canoe in the northland in any year, for the lakes and rivers are not free from ice that long.

The conquest of the north country by air is one of the most remarkable developments in all history. In effect, the year has been made two months longer, and

Saved in One

the most expensive form of transportation in civilized lands has, at even a higher price in the bush, become the cheapest available. In the "good old days" two or three years ago, the prospector started out after the break-up in the spring, and pushed forward by canoe on the heels of the retreating ice. He would have his scene of operations all picked out in advance, usually a hundred miles or so beyond the end of steel, for farther than that from transportation no one could even dream of staking a mine, and even at a hundred miles no one could be found to invest in a claim so remote.

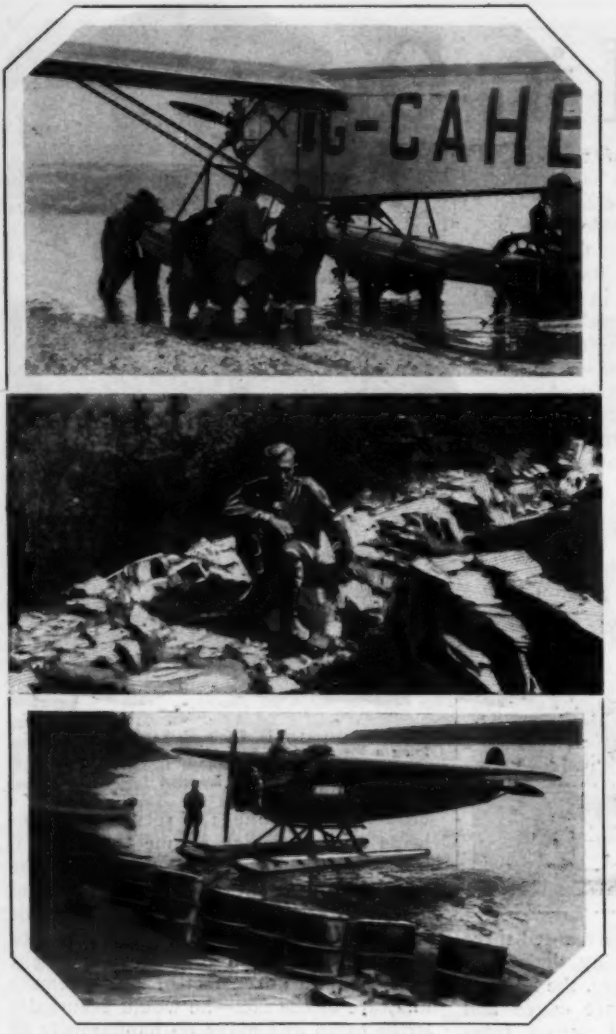


Typical Prospector in Snow Parka Examining a Piece of Ore, and, at the Left, One of the N. A. M. E. Fairchilds Being Assembled at Sioux Lookout

His hundred-mile trip represented three weeks to a month of traveling, depending on the length of the portages, the amount of clearing necessary before canoe and supplies could be carried across from stream or lake to the next waterway, and the number of fallen trees that blocked the little nameless rivers and had to be cut away before a canoe could pass.

Once at the scene he had chosen—picking blindly from a sketchy geological map—he established camp and began an aimless wandering through the bush, hacking his way practically every foot of the way through the dense stand of slim jackpine, tamarack, birch and young poplar. If by chance he stumbled across an outcrop of greenstone, the rotted pre-Cambrian rock in which all metallic mineral lodes in Canada have been found, he knocked off samples to be taken out and assayed during the winter. But, if his aimless wandering did not bring him to the greenstone outcrop—and he might pass within a dozen feet of it and remain unaware of the fact—he would eventually strike camp and move on haphazardly to some other likely-looking camping spot.

If his summer's work did produce samples, by the time he could get them out to civilization to be assayed it was too late to do anything more that year. The next season he could go back and try to uncover the extent of the visible ore body, a long, hard task with pick and shovel, cutting crisscross trenches through the overburden of decayed vegetation, rotted tree trunks, loam, clay, gravel and muskeg. With trench after trench in long



Photographs Courtesy Canadian National and Canadian Pacific Railways, N. A. M. E., and Canadian Government

Launching a Hudson Strait Ice-Patrol Ship during the Summer; Lorne Howey on His Red Lake Discovery Claim, and a Gas Cache on the Laird River

parallel rows, he would reveal the width of the face of the vein, extending his trench line until the outcrop finally dipped down too deep to reach or disappeared entirely.

That took another summer, and he was lucky if he completed it in one season. With more samples and figures showing the extent of the ore, he would spend the winter trying to enlist mining engineers, syndicates, or any other available capital, in an effort to get a backer to send an engineer in the next year to look over the claim and consider financing it.

That's the picture of the good old days, the free-lance prospecting that virtually came to an end last year.

Consider, by way of contrast, how the modern, 1929-model, prospecting outfit works. There are several of them in operation—Dominion Explorers, Consolidated, and, the pioneer and largest of them all, "N. A. M. E.," which stands for Northern Aerial Mineral Explorations, but is better known, from Abitibi lake to the Laird, and from Sioux Lookout to Victoria Land, in the arctic, as just "Name." Jack Hammell, of Flin Flon, Howey, Harker and Hurricanaw mine fame, founded it last year, and in the first short summer of operations his prospectors flew 100,576 miles, made seven important mineral discoveries, and in them staked more than fifty claims.

During the year 1929 they operated in six widely separated districts, the method in each being alike. A typical example is the Sioux Lookout district, a vast territory, 300 by 350 miles or, roughly, 100,000 square miles of northwestern Ontario, stretching from a line 125 miles north of Lake Superior to the southern end of Hudson bay.

Mining experts first flew over the entire area and studied its mineral possi-

Fairchild Monoplane Used by the Railroad and Port Authorities at Fort Churchill, Terminus of the Hudson Bay Railroad; Below, Prospectors Landing from an Airplane at Red Lake during the Gold Rush Three Winters Ago, Which First Demonstrated That Airplanes Could Save the Prospector Days and Weeks of Weary Travel

Surveyor's Emergency Office in the Kenora Country of Ontario Which Includes Red Lake

bilities from the air. The condition and kind of trees below, the occasional outcroppings of bare rock, all the signs that a trained geologist can recognize at a glance, enabled them to separate the possible ground from the barren. In that way they reduced the 100,000 miles to 4,800 square miles of possible territory, and in successive flights eliminated more until the 4,800 had been reduced to an area of not more than two townships, not in blocks, however, but in dozens of small areas scattered over hundreds of miles of wilderness.

It took only a few days to pick out from all that vast section the places where minerals in paying quantities might be found. Next came the prospectors, working in pairs. Nineteen pairs were busy during the last summer. Each pair, with a month's food, a sixteen-foot canoe, built in three sections nesting inside each other, to fit into the cabin of an airplane, a silk wall tent, tools, a box of dynamite, a rifle and similar supplies, was flown to one of the sites picked by the engineers, and landed on the nearest lake. Lakes are so thick in the north country that, given a 1,000-foot altitude, it is almost always possible to glide a disabled plane, if necessary, into the nearest landing place. The longest "dry hop" in all the 100,000 miles was nine miles between lakes.

As each prospecting party is landed, the pilot makes a date to return on a definite day, usually in two weeks. On that day one of the prospectors remains in camp, and, if the plane fails to arrive, remains there until it does. He has an orange flag and keeps a small fire going, with a plentiful supply of green branches to create smoke. When he hears the engine, he puts out his flag to mark the landing, throws branches on the fire, and sends up a column of smoke. With that system, the company has never lost a prospector in the bush, or failed to get food and supplies in on time.

When the plane returns, if the prospectors have samples, it can fly them out for immediate assay. If they have uncovered a likely-looking ore body and want advice, the district engineer can fly in in an hour or so and give it. If the samples, when assayed, prove valuable, the engineer rushes a working party in with picks and shovels, and within a few days they can cut trenches and uncover the extent of the vein. Not until then does the company bother to record the claim. Having it protected at all times, immediate recording is unnecessary, and if it turns out to be low grade or too limited to be worth working, the heavy recording expense is saved.

If, on the other hand, the prospectors, after examining all the likely-looking spots which they have studied from the air when coming in, fail to find promising ground, it only takes the airplane an hour or so to shift the camp to another site. There is no waste time in long canoe trips, and no aimless paddling in search of ground.

The First Planes into Red Lake Were Old War-Time Biplanes, with Open Cockpits; Now the Prospectors Fly in Modern Cabin Ships, Comfortably Heated in the Coldest Weather

A Prospecting Party Assembling Its Sectional Canoe; Built in Three Parts, It Nests in the Plane, and Can Be Put Together in a Few Moments When Needed; One Company Has Developed a New Type of One-Piece Canoe, Carried on Top of the Fuselage and Streamlined to Fit the Plane; Below, the First Canoe Prospectors over the Route Each Spring Have to Chop Away Fallen Trees and Clear the Road

Dog Teams Must Be Fed in Summer as Well as Winter, so the Indians Have Taken a Tip from the White Man, Appropriated His Empty Packing Cases and Constructed Wooden-Wheel Wagons, Thereby Saving a Tired Buck the Labor of Walking Down to the Traders' Post

Loafers, too, have been eliminated. In the old days, an occasional prospector would get a grubstake from a mining syndicate, paddle to some nice camping site beneath the pines and beside a good fishing stream, and spend a lazy summer at his backer's expense. With the new system, the district engineer can appear at unexpected intervals, survey the work done, and tell at a glance whether the men are working or loafing. If the latter—and this has happened once or twice—they are ordered into the plane, taken to the railroad, and put ashore.

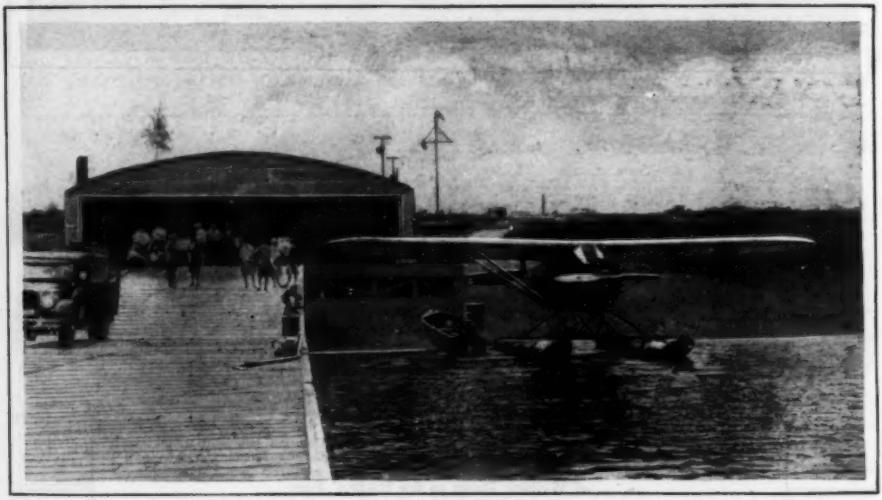
Only seaplanes are used in the busy country, though N. A. M. E. has one Loening amphibian for work in the far north along Hudson bay and through the Barren Lands to the west. Most of the air traffic of the north is handled by American ships, Fokkers and Fairchilds, with either Wright or Wasp engines. Both ships are now manufactured in branch plants in Canada, thus escaping the heavy import duties.

These two planes are admirably fitted for the work. Both were early in the field with interchangeable landing gears of wheels, skis and seaplane floats, the latter for summer landing on the lakes and skis for winter use on the ice. Both are cabin ships, giving protection from the intense cold of winter. Both have standardized on air-cooled engines, giving relief from freezing troubles in the intense cold, which frequently reaches fifty degrees or more below zero. Both have load capacities of 1,000 to 1,500 pounds, for single-motored ships, yet, particularly with the more powerful Wasp engine, can get off of very small lakes even when heavily loaded.

The Canadian government ships in the same territory, mostly provincial forestry-service ships used only in the summer for fire-patrol duty, are, on the other hand, flying boats, either war-surplus machines or modern English craft, Vicker Vimys, which are now made in a branch plant at Montreal. As the fire patrols do not fly in winter, hence do not need ski landing gear, and are usually lightly loaded, they have proved effective for that service.

The conquest of the north by planes is due not only to the enormous saving in time, but to the fact that aerial transportation is actually cheaper than anything else available. Both freight and passenger rates are high, compared with tariffs in effect on American air lines, but still under the prices for canoe or dog-team transport.

A typical case is that of a mining-syndicate field engineer who had two tons of supplies to be transported from Sioux Lookout to a claim in northern Ontario,



To Get the Sound-Movie Truck, Standing on the Dock at the Left, at Sioux Lookout, Second Busiest Airport in North America, It Had to Be Shipped In by Railroad, For There Are No Connected Road Systems

Main Street at Red Lake during the Hectic Days Following Lorne Howey's Announcement of the Discovery Claim; the Forest, for Miles Around, Was Staked through the Deep Snow

the supplies including a complete diamond-drilling outfit. To take them in by canoe would have cost slightly over $1,000 and taken from three to four weeks' time, a very important factor as the time was early August and the season drawing toward its close. One of the commercial air lines offered to do the job for $350, and could make delivery of the entire two tons in one day.

Sioux Lookout, just a wide place in the road until last year, was a typical little railroad division point, with a couple of thousand population. Twelve months later, it laid claim to the title of second largest airport in North America—in the western hemisphere as far as that goes—exceeded only by Chicago in the number of daily arrivals and departures and the amount of freight and passengers moved.

Standard passenger and express rates are in effect for every mining camp within a radius of 200 miles. Outside of that district, ships are available on a few hours' notice to fly anywhere from Ungava, opposite Greenland, to the Yukon, and from the American border to the Arctic. All that vast land is studded with gasoline and supply caches, some of them with two years' supply of gasoline, oil, spare parts and food.

The charter rate on the principal commercial air line is $1.15 a mile, the charterer paying for the return mileage, whether or not he comes back. If he holds the plane over while he inspects claims, he pays $50 a day. These rates are so much cheaper than canoe or dog teams that virtually everybody having business in the north country flies.

The extent to which airplanes are used, and the vast amount of traffic handled, is all the more surprising when it is learned that, on June 30 of last year, there were only 337 commercial and private airplanes in all Canada, and that 113 of them had been added during the first six months of 1929. In spite of the limited number of planes, 74,669 passengers were carried and 2,404,682 pounds of freight handled in 1928, when the business had barely obtained a start.

While the aerial-exploration period did not actually get under way on a large scale until the spring of 1928, the use of airplanes in a gold stampede really dates from 1924, when the Laurentide Air Services, Ltd., established the first regular air

Tractors Proved Their Worth on the Hudson Bay Ice Patrol, Hauling Supplies and Dragging the Planes Down to the Ice in Winter and to the Water's Edge in Summer

route in Canada to fly passengers in to the Rouyn mining district, in northern Quebec. The service ran daily from Haileybury, Ontario, to Lake Osisko, and in the first summer carried more than 1,000 passengers, 15,000 letters and 78,000 pounds of freight. An attempt to continue on skis during the winter was not very successful, as the equipment then available was unsatisfactory. The arrival of the railroad at Rouyn ended the business, but by that time planes and flyers were available to take advantage of the Red Lake gold rush in the winter of 1925, the Flin Flon and Cold Lake developments in 1926, and new mine fields in central Manitoba in 1927 and 1928.

Western Canada Airways, the principal commercial company, as distinguished from the prospecting organizations, such as N. A. M. E., which operates its own ships to carry only its own men and supplies, handled, from Jan. 1, 1927, to March 31 of last year, a total of 13,226 passengers, 1,890,314 pounds of freight, 195,021 pounds of mail, and flew 844,536 miles, in 10,314 hours in the air.

From the operation of one plane in January, 1927, the organization expanded to thirty-two in the spring of 1929. In 1927, it flew forty men and thirty-five tons of supplies, including diamond drills, from The Pas to the Sheritt-Gordon mines, 100 miles northwest of The Pas. The entire mining camp, and everybody in it went in by air. In the fall of 1928, when the writer visited the Western Canada base at The Pas, seven ships were being used to ferry supplies from Cranberry Portage to Cold Lake, and, though they had been working for two weeks, there was still thirty tons waiting to be moved in before the freeze.

The freeze-up in the fall and the thaw in the spring are the only things that stop flying in the north. There is about a month, while the ice is forming, and a month while it is thawing, when neither pontoons nor skis can be used, so that period is set aside for semiannual overhauling of equipment and for vacations for pilots.

(To Be Continued Next Month)

HAND-OPERATED CHECK WRITER PRINTS AND CUTS AMOUNT

Printing and cutting the exact amount of a check in acid-proof ink, a hand-operated check writer now is on the market that is self-inking and automatic in feeding. Except for the inking arrangement, the writer operates somewhat like the ordinary seal impression and defies the efforts of check raisers. It is simple and fast to operate. The compactness appeals especially to travelers.

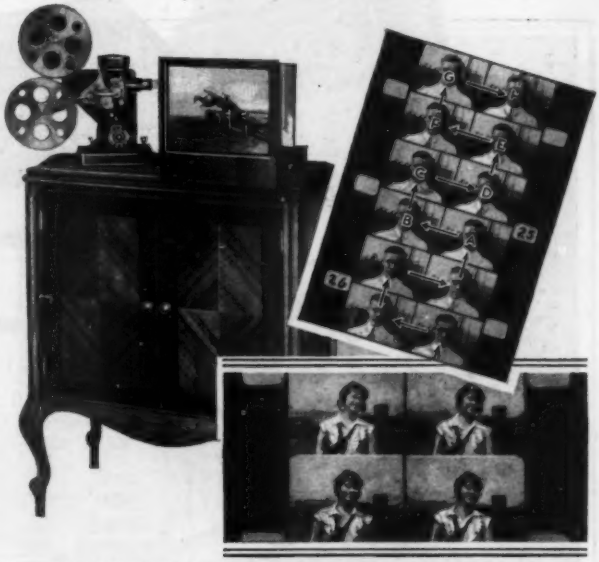
MICROBES HELPED MAKE COAL

Hardy microbes that lived on wood and remained active for more than nineteen months, probably assisted in the formation of coal, bureau of mines scientists believe. Tiny organisms were discovered during an analysis of peat. The microbes, according to the investigators, give rise to changes in the nature of the peat.

PIANOS CARRIED ON HORSEBACK

Pianos constructed to fit the back of a horse are being turned out by a German manufacturer for delivery to remote regions where mountain trails or almost impassable roads make the horse the only possible means of transportation. The upright piano made to travel horseback has a U-shaped lower section which fits the animal. Other pianos are made dismountable, so that they can be transported in several packing cases on the backs of mules, and assembled on delivery, because the instrument would be ruined were it to be hauled over many of the trails for hours, and often days, in a cart drawn by oxen.

Piano Designed for Transportation on Horseback to Sections Where Roads Are Scarce

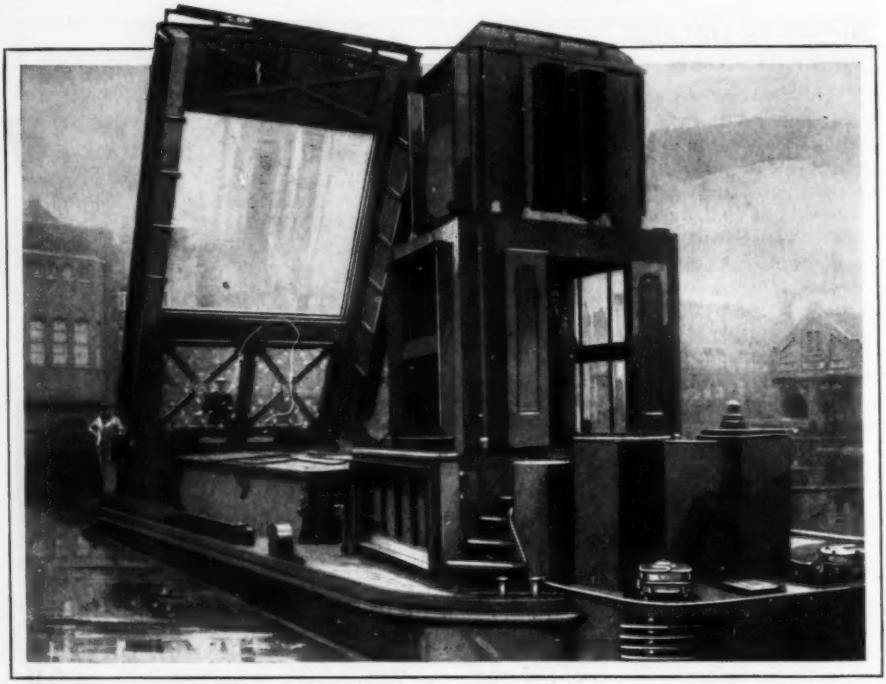


Home-Movie Outfit Takes Pictures Crosswise on Film as Well as Lengthwise; Inserts Show Sections of the Film

MOVIES ARE SEEN IN DAYLIGHT WITHOUT DARKENING ROOM

Enabling the showing of home movies in daylight without darkening the room, and allowing the taking of four pictures in the same space formerly occupied by one, thus reducing the cost of film, a new type of home-movie outfit has been developed. The cost of film has been reduced about seventy-five per cent by an apparatus allowing pictures to be taken crosswise, as well as lengthwise, of the camera. The film is of standard width, but gives four vision impressions instead of one in the same space. The two movements, bringing the film across the front of the camera as well as moving it horizontally, alternate. The projector includes a device known as a daylight recreator, by means of which the picture is projected against a mirror at an angle of forty-five degrees, that reflects the picture through a translucent glass screen in all the fine detail of daylight.

¶We want all our readers to write our Bureau of Information whenever they wish additional information on articles published in this magazine.



Courtesy Johnson Motor Co.

Mounted on Barge, This Moving-Picture Show Travels Holland's Canals; Projector and Screen Are on the Boat While the Dutch Movie Fans View the Films from the Banks

A MOVIE THEATER THAT MOVES TRAVELS HOLLAND CANALS

Holland's numerous canals have been utilized by an enterprising Dutch movie-theater owner to transport his traveling show from place to place. The moving movie is mounted on a barge, with a steel structure to house the projector and a tilted frame in front of it for the screen, spectators observing the performance from the banks of the canals. The barge is driven at a slow rate of speed.

DANGER ON COUNTRY ROADS GREATER THAN IN CITY

Small towns and country roads are more dangerous than the streets of large cities so far as automobile accidents are concerned, according to a study made by the Connecticut department of motor vehicles. Accidents in the cities were found to be more numerous but less serious. In 1928, there was one death in every forty-one accidents on highways, and one death in every seventy-five accidents in twenty-one incorporated cities. Of the rural accidents, fifty per cent caused personal injuries, and in the cities, the ratio was forty-one per cent. More than twice as many accidents were recorded in cities as on country roads, however.

FENDER AND BODY-REPAIR TOOL FOR DAMAGED AUTOS

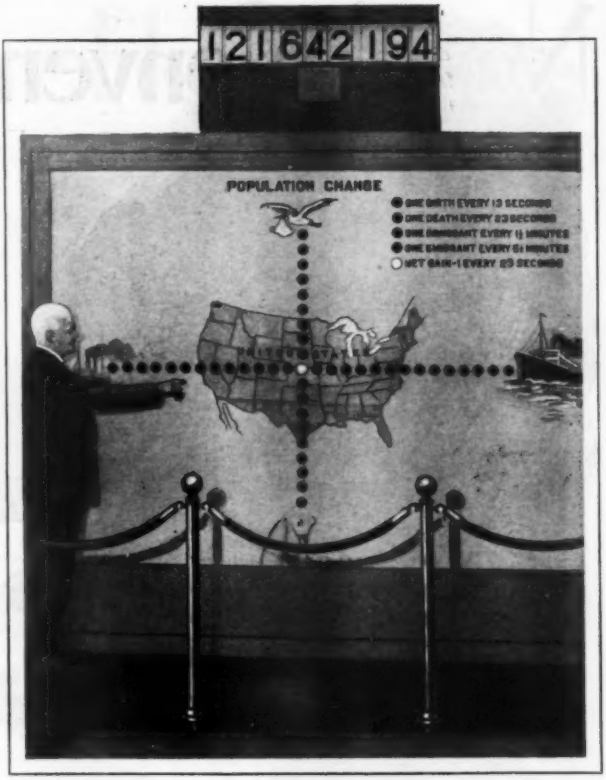
Everything pertaining to a jack that is required for the repair of damaged fenders and automobile bodies is contained in a single tool now on the market. It consists of the jack, a thirty-six-inch screw and threaded pipe of similar length, together with various-shaped parts to be attached to the ends of the tool for the different repair jobs.

QUALITY OF WOODS IS REVEALED BY TESTS

More than 130,000 tests by the United States forest service show that hickory is the heaviest wood grown in this country, and the lightest wood when green is western red cedar. Green hickory is slightly heavier than water and will not float. When kiln-dried, it has a weight of fifty-five pounds per cubic foot. When green, canyon live oak is slightly heavier than hickory, but loses more weight when dried. Western red cedar weighs twenty-four pounds per cubic foot when green, and three pounds less when dried. Black locust grown in Tennessee is strongest in resisting bending, being sixty per cent stronger than oak. Black willow is the weakest in this quality. Black locust also is strongest in resisting compression parallel to the grain, while osage orange grown in Indiana is strongest in resisting compression perpendicular to the grain. Blue gum is the stiffest wood and osage orange is the hardest grown in the United States.

DISCOVER TWO NEW VITAMINES

No less than two new vitamines have recently been discovered by English scientists. Regarding one of these, the scientists do not yet know whether it is necessary for the human race, but experiments have proved that it is necessary for the growth of that all-important animal, the experimental rat. No name has yet been given to this vitamine. It has been found in fresh milk, lettuce, grass, ox muscle, liver, and wheat embryo. The other discovery is a new variant of vitamine B.


121 642 194
POPULATION CHANGE
ONE BIRTH EVERY 13 SECONDS
ONE DEATH EVERY 23 SECONDS
ONE IMMIGRANT EVERY 1½ MINUTES
ONE EMIGRANT EVERY 6½ MINUTES
NET GAIN-1 EVERY 23 SECONDS

© U. & U.

Flashing Lights on This Chart Record Deaths and Births in the United States, Thus Providing a Constant Estimate of Population

DAILY CHANGES IN POPULATION SHOWN BY MACHINE

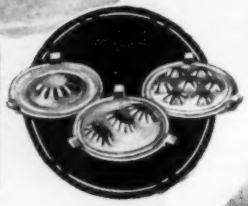
Providing a constant and reliable estimate of the population of the United States, an interesting calculating machine is now in use at census headquarters. It is electrically operated, a tiny light flashing each thirteen seconds to indicate a birth, another every twenty-three seconds to show a death, and other flashes indicating the arrival of an immigrant or the departure of an emigrant. A counter at the top of the chart indicates an estimate of the total population of the nation at any time. The average gain is one every twenty-three seconds.

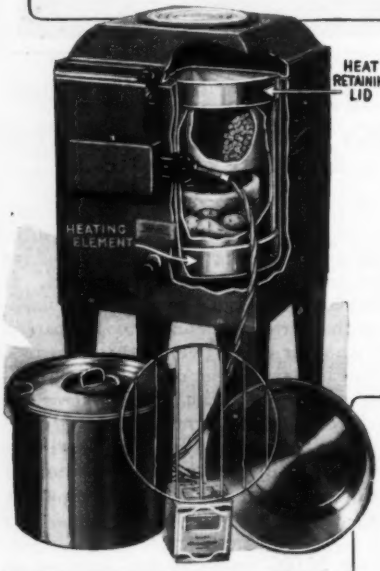
About 50,000 rosebuds are required to make one ounce of the oil of roses.

New Conveniences

Safe and Convenient Electric-Iron Holder Prevents Fires and Prolongs Life of Cord, Which Is Wound on Reel in Base; Current-Control Button Is at Top of Cord Compartment, Socket Plug at Side

Batter Is Poured into Container and Pressed through Molds with Plunger, to Make Cookies in Quick and Sanitary Manner





Four Vegetables and Meat Enough for Six Persons Can Be Prepared at One Time in This Electric Cooker, Which Retains Flavors and Uses Little Current

Quickly Attached to the Broom, This Mop Simplifies Cleaning Floors and Reaches Difficult Places; It Is Washed like a Towel and May Be Used on Walls without Scratching Them

for Your Home

Useful Cooking Parchment for Wrapping Vegetables Permits Preparing Three or More Kinds in Same Pot and Also Is Serviceable for Preserving Foods, Wrapping Wet Bathing Suits and Many Other Purposes; It Prevents Spread of Cooking Odors

Here Is a Washing Machine That Operates Somewhat like a Percolator; Hot, Soapy Water Is Automatically Sprayed on the Clothing; It Is Light and Suitable for Gas, Electric, Coal or Wood Stoves; Suction Forces Water through the Fabric

Compact, High-Speed Electric Range Utilizes Reflected Heat, Is Automatically Controlled and Has Flashing Signal That Lights Once a Minute with the Heat; Interior Is Chrome-Plated

Mop Handle with Rod Running through It, Eliminates Stooping Over; to Wring the Rag, the Knob at Top Is Turned

Passengers on a Transcontinental Plane Enjoying a Movie Show; Movies Are to Be a Form of Diversion for All Such Ships

MOVIES ON PASSENGER PLANES ENTERTAIN TRAVELERS

Passengers on transcontinental airplanes soon may expect to be entertained with a regular program of moving pictures when they tire of watching the scenery. The Transcontinental Air Transport, cooperating with the Universal Pictures corporation, tested the form of entertainment, using a projector weighing only six and one-half pounds and exhibiting six reels of comedy and news pictures during the trip from Columbus, Ohio, to Waynoka, Okla., on the journey. The tests were judged entirely successful.

MOST POWERFUL MICROSCOPE OPENS NEW WORLD

Capable of magnifying an object as high as 2,250 times its natural size, and of shifting the magnification from the lowest to the highest, or vice versa, at the touch of the operator's hand, what is believed to be the most powerful microscope has recently been completed. It is designed to give the scientist the advantage of both monocular and binocular vision and to permit minute examination of an object, and unites a number of precise operations into one. Once the glass is focused, no further adjustments are necessary to change its magnifying power. It is equipped with four nosepieces, enabling a shift from first to fourth power without moving the object under scrutiny.

PLANES CHANGE MAIL IN AIR

Transferring mail bags in the air from mail planes to other ships ascending to meet them at way stations has been accomplished successfully in experiments in Germany. The mail is dropped from one plane and snatched by another by means of a hanging cable with a forklike hook attachment. The cable breaks easily if caught by an obstruction, thereby preventing a crash.

TOP EMPTIES CONTENTS OF JUG WITHOUT TILTING

Spilled liquids and unsanitary containers both are avoided with a decanting bottle stopper for home beverages now on the market. The appliance fits in the ordinary gallon jug and consists essentially of a rubber stopper, a rubber bulb attachment by which pressure is applied to the liquid, and a knob on the top to regulate the flow. As the liquid in the jug is lowered, more pressure is applied to that remaining.

TREE RINGS WILL REVEAL AGE OF PREHISTORIC RUINS

Timbers collected from the famous Pueblo ruins of the southwest are relied on by investigators for the National Geographic Society to reveal the age of all such prehistoric pueblos with any wooden beams remaining. The principle of the tree-ring calendar is that the rings added to a growing tree each year vary in dry, moist and average seasons, so that any given ring is like a date mark. By examining cross sections of old trees and tracing back the overlapping series of tree-ring dates, it is expected the age of the ruins may be fixed. This tree calendar is carried back to 1260 A. D., and still it is not far enough back to match the series of years recorded in the pueblo. Another set of tree-ring dates covers 586 years in some unknown centuries, and investigators claim the link between the two has now been discovered, making it possible to fix the ruins' age.

Automobile-Motor Tester Whose Dials Reveal Valve Defects, Distributor Conditions, and Check Plugs, Carburetor and Gaskets

VISUAL PROOF OF AUTO DEFECT SHOWN BY MOTOR TESTER

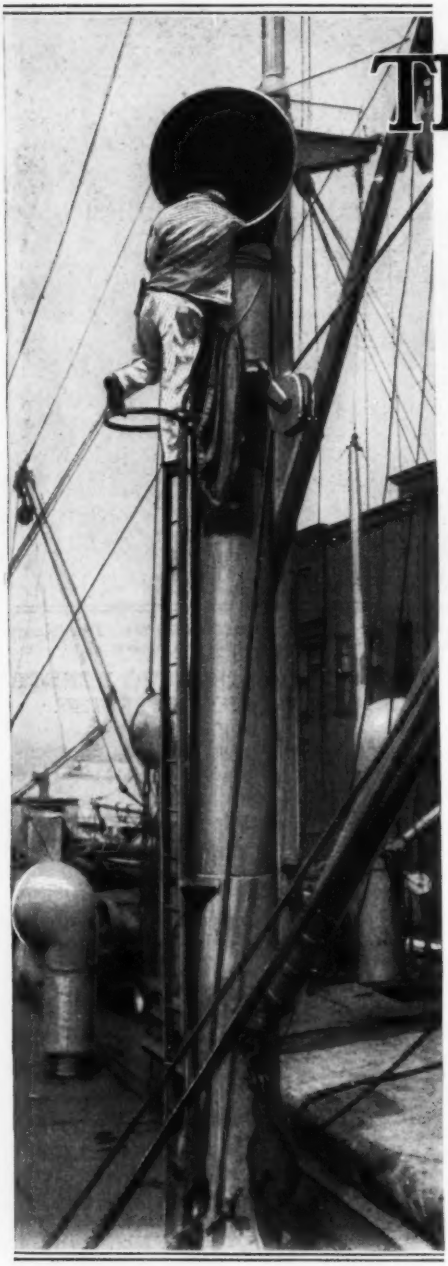
Revealing motor conditions as accurately as laboratory testing equipment, an inexpensive automobile-motor tester now is available for the use of service stations. The tester has three dials or gauges, including a neon tube, cylinder-balance gauge and vacuum meter. These instruments distinguish between leaking and sticking valves, late timing or weak valve springs, and also reveal all distributor conditions, including breaker points, rotor and governor. They differentiate between coil, condenser and high-tension-wire trouble, check plugs, carburetor and gaskets, individual cylinder balance, and show the vacuum pressure.

SPRING TOP FOR CIGARET PACK SERVES IN PLACE OF CASE

Easily inserted into the paper cigaret package, a metal frame with spring top protects the contents and converts the pack into a case that will not crush in the pocket. To open the lid, slight pressure is applied with the fingers to the sides of the frame. This causes the top to fly up. It snaps shut and holds securely. The frame fits the paper packages of a number of common brands of cigarets.

Metal Frame for a Cigaret Package Which Answers the Purpose of the Carrying Case

TRICKS of the



Searching a Vessel's Air Shaft, a Favorite Hiding Place for Smuggled Goods

SMUGGLING, practiced extensively throughout American ports by a cunning twentieth-century species of the pirate, has become a lucrative profession as well as a pastime. Last year, over $100,000,000 worth of diamonds alone were smuggled into the country, according to government reports.

Uncle Sam has found his mental capacity taxed considerably in coping with the wits of the smugglers. A vast system of custom-service guards has been organized to run down persons attempting to bring goods into the country without paying the duty levied on them. Although the government officials do not pretend that they have brought smuggling within control, they believe it has diminished greatly within the last two years. On the other hand, with the increase of federal vigilance, there has been a corresponding development in the ingenuity of the smugglers' tricks.

New York, where an average of 200 ships dock a day, has been the smugglers' paradise. The Mexican and Canadian borders have also been used by these secret runners; the idea, in the latter cases, being that the duty in those countries on diamonds would be about six per cent and by paying that amount they would gain the balance of the American twenty-per-cent duty after crossing the border lines.

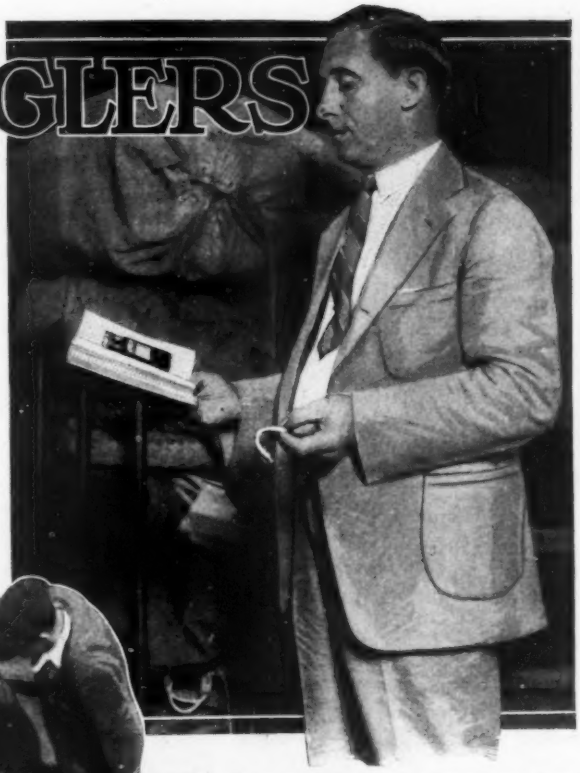
George H. Brewer, assistant solicitor of the port of New York, constitutes the court before whom all detected smugglers must appear when apprehended entering that city. His records show that last year 400 men and women were caught at various degrees of smuggling. Of this number, 186 were women and this fact has revealed that women are the cleverest of the smugglers. They are far more artful than men at dodging detection, according to inspectors.

Scanning his record book with more studied scrutiny, Mr. Brewer found that most of the 214 men who had been caught were accompanied by their wives or

SMUGGLERS

daughters. He went on to declare that ninety per cent of these paid fines because their wives or daughters had been the culpable ones and they were taking what is known in criminal parlance as "the rap."

A heavy congressional report unfolded the manner by which the government seeks to curb smuggling. It was known by the treasury department that a well-organized international smuggling ring



William Staley, of Post Office Department at Washington, D. C., Showing Dope Bottle Concealed in Book and False Teeth Containing Dope; Left, Officers Searching a Suspected Fishing Smack

existed which sometimes sent $500,000 worth of cut diamonds into the country without paying the twenty-per-cent duty.

John W. Roberts, head of the diamond squad of the department, exposed this ring as having agents in Paris, Berlin, London, Ottawa and Montreal, with New York as its American headquarters. Meyer D. Rothschild, of New York, president of the American Jewelers protective association, tells of two American women in Paris. One bought a pearl necklace for $800,000, and her sister another for $500,000. One of them also bought an emerald necklace for $400,000. The purchases and the duty amounted to about $2,000,000.

"When you compare that sum," said Mr. Rothschild, "with the total declared importations into the United States you get a sinking reaction. The purchasing of diamonds and jewelry abroad by dealers and travelers probably amounts to $150,000,000 annually, and yet our customs reports show only one-third of that."

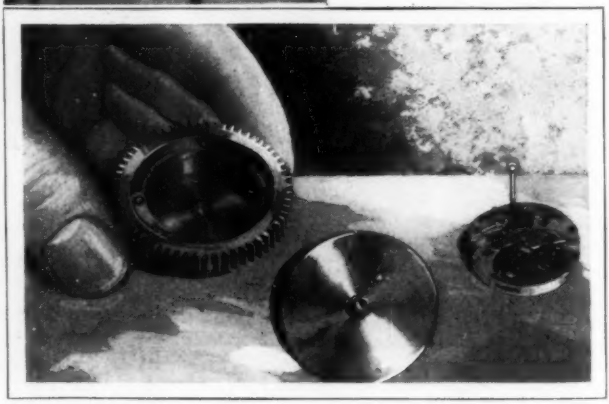
The individual smuggler, spurred on by hopes of avoiding payment of duty on some trinket—and often with him, or her, it is only a sportive pastime—has not caused the diamond squad much worry. This person hides jewelry in coat sleeves or other parts of clothing down to the inner part of the heel. The passengers' bag of tricks is well known to the custom officer. These so-called second-rate smugglers hide their gems away in shaving-cream or tooth-paste tubes, fountain pens, within chocolates and soap, tobacco pouches, cigars, cigaret lighters, and almost every object the traveler carries which will lend itself to concealment.

Quite frequently within the past year, the government has collected handsome fines from passengers who have tried to bring in dutiable goods clandestinely.

Mr. Brewer's record book is a cross section of the social registers of New York, Philadelphia, Boston, Washington and Chicago. Socially, as well as financially, prominent personages resort to smuggling, not because of the duty involved but because of a spirit of adventure.

From June 1, 1928, to May 31, 1929, authorities of the port of New York collected $1,413,602 from persons who failed to declare objects on which there was a duty. On the other hand, reports of declared values show a steady and substantial decline. In 1919 they were $64,222,927. In 1927 the value was $40,733,351, and for the first ten months in 1928, $35,523,610.

It is the world traffic which has baffled the custom-service officials. This is a highly de-

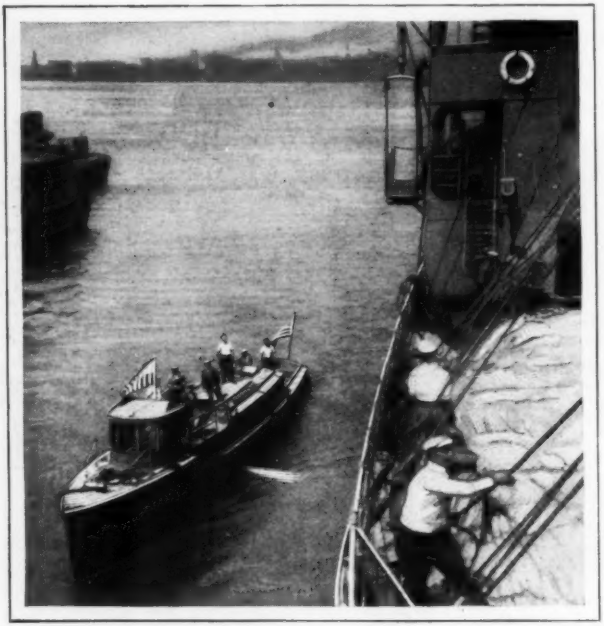


Hollow Heel That Contained Smuggled Articles; Trick Bolts Used to Disguise Official Seals, and Gear Wheel That Concealed Goods

Top, Smuggled Gems, Valued at $60,000, Were Hidden in an Old Brush; Below, Crew of Custom Officers Boarding a Liner

veloped organization, operating on a vast scale. Millions of dollars are in the balance, and it is run with as much efficiency as any legitimate industry. In this higher branch of smuggling, the lawless diamond merchant goes to Antwerp and makes his purchases. He buys diamonds here and there until he has his supply. He might go in for other gems, but the returns are highest on diamonds. Next he makes a deal by which the transfer of the diamonds to New York is guaranteed by some form of insurance. Carriers are picked. These are men and women not known to each other. They come to America. Many times they are members of ships' crews. Thousands of these come into the port of New York every day, not only on passenger liners but also on freighters. The latter, too, are kept under close surveillance because of their cargoes and multitudinous hiding places.

A person posing as a poor immigrant, the last one to bear a shadow of suspicion, will spend his time in the steerage with several hundred thousand dollars' worth of diamonds hidden upon him or in some part of the ship. He reaches New York and then delivers the cargo. Often he meets his consignee on the street, or at some "speak-easy" or other hide-away



U. S. Custom Raiding Crew in Motor Launch, Approaching an Italian Freighter Preparatory to Search for Smuggled Articles

place. The tryst is skillfully arranged, as there must be no loopholes in this wholesale smuggling operation. The masters of these rings see to that.

It frequently happens that the carrier receives his package in Paris, London, or some other city far from Antwerp. This runner is the one who works via the border lands. He uses many tricks in hiding the gems. He employs the lining of suitcases as well as the lining of his coat. He finds the border regions not so impregnable for his activities.

A cleverly organized espionage system has been very effective in checking the operations of the smugglers. The treasury department now has spies scattered throughout the large cities of Europe and ports of Mexico and Canada. The profession of being a spy in the smuggling world has been as profitable in many instances as that of smuggling itself. It has made comfortable fortunes for many a man formerly in humble circumstances.

This is how the spy works: You may be a member of a gang which is suspected of engaging in smuggling. He will adroitly get into the ring and in time he will reveal its secrets. That is simple. That is, it is a plain case of deception and then telling. When the United States officials make the seizure in an American port, the spy gets one-fourth of the value of the jewels.

On the other hand the spy may be a jewelry-store clerk in Paris or London. He will take down a description of the jewelry you buy, together with your name. He will forward this to the U. S. custom service. If you declare the baubles, he gets nothing. But should you fail to do so and they are found in your possession, then again the spy gets one-fourth of the gross.

By the gross is meant the original value of the article plus the original value again, which represents the fine, with double the amount of the levy thrown in. That is, if you bring in an article worth $1,000 and fail to declare it, it is assessed with the levy, which may be about $600. That makes $1,600 which the article is worth in America. Added to that will be a fine for smuggling it equal to its original value plus the tax. That makes the article worth $3,200, which you must pay to recover it. The spy, who in this case was a foreign jewelry-store clerk, gets one-fourth of that, or $800. Often these spies have received as high as $50,000, the records show. For the ten months up to May 20, 1929, the United States treasury paid $148,919 to 203 persons for information leading to the detection of smuggling of goods on which the government collected $600,000 in redemptions and penalties.

This outlaw field of activities is not without its cheating cheaters. There have been instances, officers of the custom service report, where the carriers employed by leaders of the international smuggling rings, convert the diamonds or other gems

to their own use and fortune on arriving within the country.

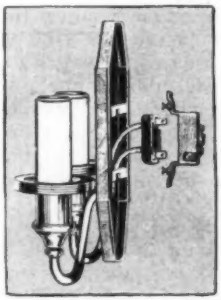
It is pointed out that a carrier entrusted with a $500,000 diamond cargo might easily forget to return to his starting point for more when he considers his own chances of keeping what is in his own possession—and runs no risk of ever being caught, either by the government or by those who trusted him.

WHY RACING TIRES LOSE AIR

Experiments with tires to be used in attempts to break world speed records disclosed that they all deflated when revolved at a rate of speed equivalent to 200 to 300 miles an hour. The tires held their pressure for days at a time, but when revolved for high-speed tests, would deflate quickly. Finally some one, almost in despair, soldered the end of the valve stem, and the tires held. It was then determined that the centrifugal force of high-speed spinning was sufficient to depress the valve core and release the air.

MOVABLE LIGHT FIXTURES ADD BEAUTY TO HOMES

Lighting fixtures, heretofore considered as permanent as windows once they were hung in place, now may be made as portable as pictures with the use of two appliances, one designed to support ceiling lights and the other for wall lights. The ceiling attachment fits into a standard outlet box, the device forming the cover for the box. Wiring connections are made to screw terminals, the plug is attached to the wires of the ceiling fixture by the same method and electrical connection is made by plugging in a hook coming through a slot in the plug to support the hanging fixture. The wall appliance is similar except that the mechanical support is accomplished by means of a bracket back equipped with two straps.



PORTABLE SHOW-CARD WRITER FOR NOVICE IN PRINTING

A Portable Show-Card-Writing Outfit, Enabling the Novice to Print Attractive Display Cards

Requiring no experience to operate, a portable show-card-writing outfit now is on the market which enables a novice to produce attractive printed signs for window displays. The equipment includes letter tracers, rules and outlines of drawings and is contained in a compact case.

FAN FORCES MANIFOLD HEAT INSIDE THE CAR

Heat from the manifold of the new Ford car is utilized to keep the automobile warm with a power fan now on the market. The equipment consists of a cap for the open end of the manifold, a fan and motor to carry the heat into the car, a heat deflector and a control switch. The heat is distributed evenly throughout the car by the deflector, and the amount entering the car is under control of the driver. The heater is quickly installed and costs little to operate.

A Universal-Voltage

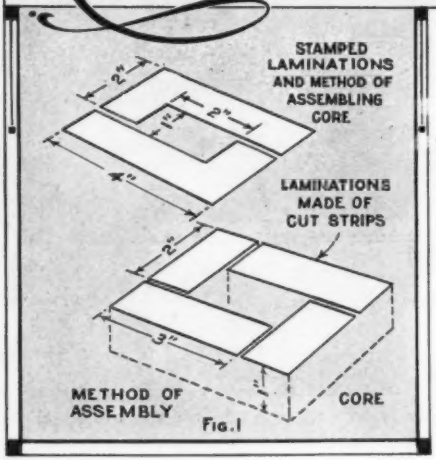


Fig. 1

By J. S. Hagans

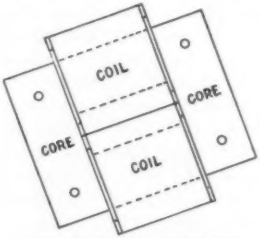
THE MODERN a.c. receiver requires a variety of filament voltages ranging from 1.5 upward and, therefore, it becomes necessary to provide a suitable step-down transformer for the 110-volt 60-cycle supply line. This article describes such a transformer.

The first thing to consider is the core, usually made from silicon steel, and not always easily available at hardware or radio stores. While it is possible to make your own laminations, it requires more patience and time than you may care to devote to the work. Recently it has become possible to buy laminations punched and with sharp clean edges, all ready to assemble. Laminations may also be taken from old transformers picked up at power companies or junk dealers, and these are easily cut to the required size. Using the L-type 29-gauge stamping illustrated, about 150 will be required to build up a core having a cross section of 1 in., as illustrated in Fig. 1.

The next step is the construction of two spools or forms, both of the same size, on which the primary and the several secondaries are wound. Fiber is best for this purpose, although cardboard, or almost anything but metal, can be used. The four endpieces are cut from 1/16-in. fiber, as detailed in Fig. 2. The center is located by drawing diagonal lines and then laying out the opening for the core. A pair of tin snips is handy for cutting this stock, while the inside opening can be cleaned out along the layout lines with a sharp chisel and dressed with a file. Two cores, made from 1/32-in. fiber, will be required, and while the dimensions for these are given in the drawing, it is best to form the core spools directly on the transformer-core material. In this way, the builder will know that the core can be easily assembled, provided the wire has not been drawn so tightly that the diameter of the fiber form is reduced.

There are a variety of ways to wind the coils, but by far the simplest method is to use a coil winder equipped with a counting device, especially when winding the primary of 660 turns. Keep this winding in layers and cover each layer with thin insulating paper. The ends of the primary winding are anchored by running them through small holes drilled in the endpieces, leaving several inches of the wire at each end to be soldered to the power-supply wires.

When this primary coil is completed, wrap it with a layer or two of friction tape and set it aside. The secondary coils are somewhat simpler to wind, as heavier wire and fewer turns are used. The type of wire and number



COMPLETED TRANSFORMER ASSEMBLY

Filament Transformer

of turns for all coils are given in Fig. 2A, all being d.c.c. These tu[illegible] are wound [illegible]e second form i[illegible] given or [illegible]anged to s[illegible]it [illegible]eeds of the [illegible]. It may be well, ho[illegible]ever, to leave the 2.5-volt winding until the last on account of the larger size wire, which is stiff and more difficult to handle. Wind these coils in layers as in the case of the primary. The coils are all wound separately, and a few inches of wire is left at the ends for later connection to the panel. Each of these leads can be brought out through holes drilled in the endpieces of the coil form at either end, as the windings are laid on. These terminals should be carefully tagged for identification. After the windings are in place, cover with a layer or two of friction tape. The provision of additional secondary voltages to meet individual requirements is merely a matter of more or fewer turns of wire. The 5-volt secondary will handle as many as four 171-A tubes, while current for two 210 and two 281 rectifier tubes is supplied by the two 7.5-volt windings. Four heater-type 227-tubes, requiring 2.5 volts, and as many as three of the 226-tubes from each of the 1.5-volt circuits may be operated with the windings specified, making this a truly universal filament-heating transformer. In cases where Arcturus or similar tubes of the 15-volt type are used, the two 7.5-volt windings may be connected at the center to supply the necessary voltage. Similarly, the 5 and 2.5-volt windings may be connected to produce 7.5 volts, or any like combination. It is not necessary to wind all the secondary windings if only certain voltages are required; certain windings may also be duplicated where a number of tubes of the same type are used and the amperage from one winding would not be sufficient.

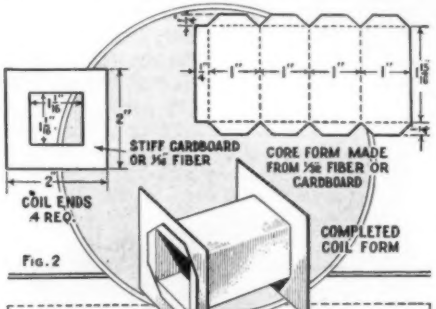
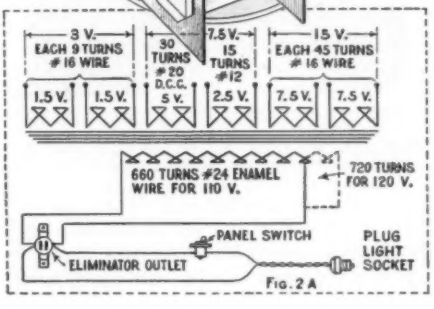


Fig. 2


3 V. EACH 9 TURNS # 16 WIRE
30 TURNS # 20 D.C.C. 5 V.
7.5 V. 15 TURNS # 12
15 V. EACH 45 TURNS # 16 WIRE
1.5 V.
1.5 V.
2.5 V.
7.5 V.
7.5 V.
660 TURNS #24 ENAMEL WIRE FOR 110 V.
720 TURNS FOR 120 V.
PANEL SWITCH
ELIMINATOR OUTLET
PLUG LIGHT SOCKET
Fig. 2A

The finished coils, both primary and secondary, should now be tested for open circuits, which is easily done with a dry battery and a pair of headphones or a voltmeter, connected in series with each coil. A click in the headphones or a deflection of the meter indicates that the circuit is complete. The coils are now ready for assembly on the transformer core and the

laminations are inserted from opposite sides in such a manner that the joints of the first layer will be broken by the second layer, and so on. If the coil forms have been properly made, the total number of laminations will fit quite snugly, and there will be no need of clamping the assembly together.

The panel should be made of bakelite or similar insulating material, but hard rubber cannot be used, as will be explained presently. Two holes for each of six secondary windings are drilled in the panel with a No. 35 drill and tapped with a 6-32 tap for round-head brass machine screws. A soldering lug is placed under the head of each screw, which is then turned tightly into what will be the front of the panel. Binding posts instead of screws may be used if desired.

The secondary terminals may be connected to the panel in any desired arrangement, and these leads should be carefully soldered to the screws at the rear of the panel. Insulated hookup wire may be used to extend the leads to the panel, and each soldered connection must be carefully taped or insulated with rubber tubing. Make each lead as short and direct as possible and keep them well apart. A ⅜-in. hole is drilled in the panel at a convenient point for the 110-volt leads which are connected to the primary winding. These leads should be anchored just inside the panel with five or six turns of tape, to relieve strain and to prevent leakage when sealing compound is poured into the metal container. Now test the circuits again to be sure that all connections have been properly made.

The tin can or container, detailed in Fig. 4, is quite simple. A half sheet of tin will be required, and it is only necessary to place the scribed lines over a sharp edge and bend it as desired. The bending tool described in the article on the home construction of stage shields in the August, 1929, issue may be used for this bending operation.

When finished, the can will have only four sides, with flanges turned over on the fifth to hold the panel, which is inserted from the top. If desired, a hole may be drilled in the top of the can for a convenience outlet, which is connected in parallel with the 110-volt line. This out-

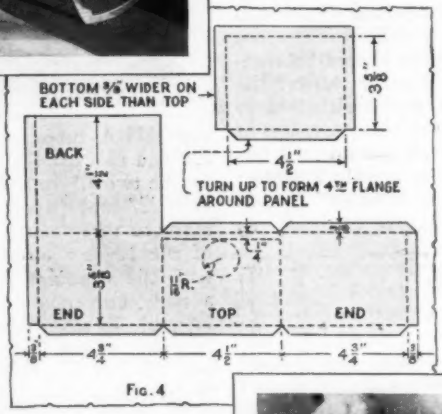
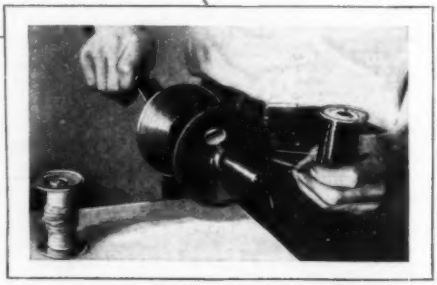
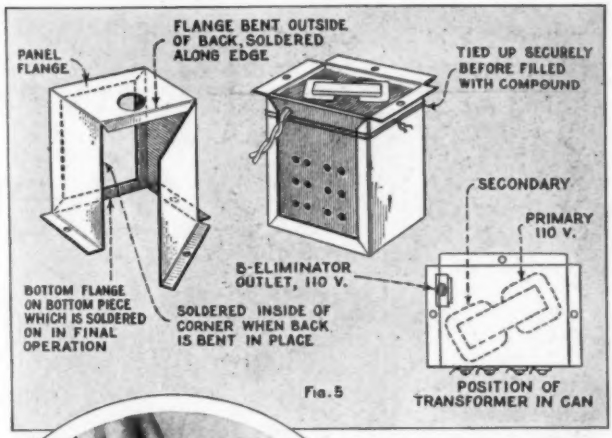


Fig. 4



Cutting the Sheet Tin to Form the Container; Template for Container, and Winding the Primary Coil

let is for plugging in the B-eliminator on the same circuit, so that, when the panel switch is operated, both filament and plate-circuit supply will be on or off simultaneously. This arrangement will make it necessary to mount the transformer inside the can at an angle, as shown in Fig. 5. When this outlet is soldered and the joints taped, the panel and its attached transformer are pushed into the can. The fiber coil ends will prevent the ends of the transformer from coming in contact with the can, but it will be necessary to see that the sides are placed in such a position that they will be at least ¼ in. from the housing. If any difficulty is experienced here, use a wad of tape between the transformer core and the sides of the can.


FLANGE BENT OUTSIDE OF BACK, SOLDERED ALONG EDGE
PANEL FLANGE
TIED UP SECURELY BEFORE FILLED WITH COMPOUND
SECONDARY
PRIMARY 110 V.
B-ELIMINATOR OUTLET, 110 V.
BOTTOM FLANGE ON BOTTOM PIECE WHICH IS SOLDERED ON IN FINAL OPERATION
SOLDERED INSIDE OF CORNER WHEN BACK IS BENT IN PLACE
POSITION OF TRANSFORMER IN CAN
Fig. 5

Details of Can and Transformer Assembly; Left, Connecting Switch in Series with the Supply Line

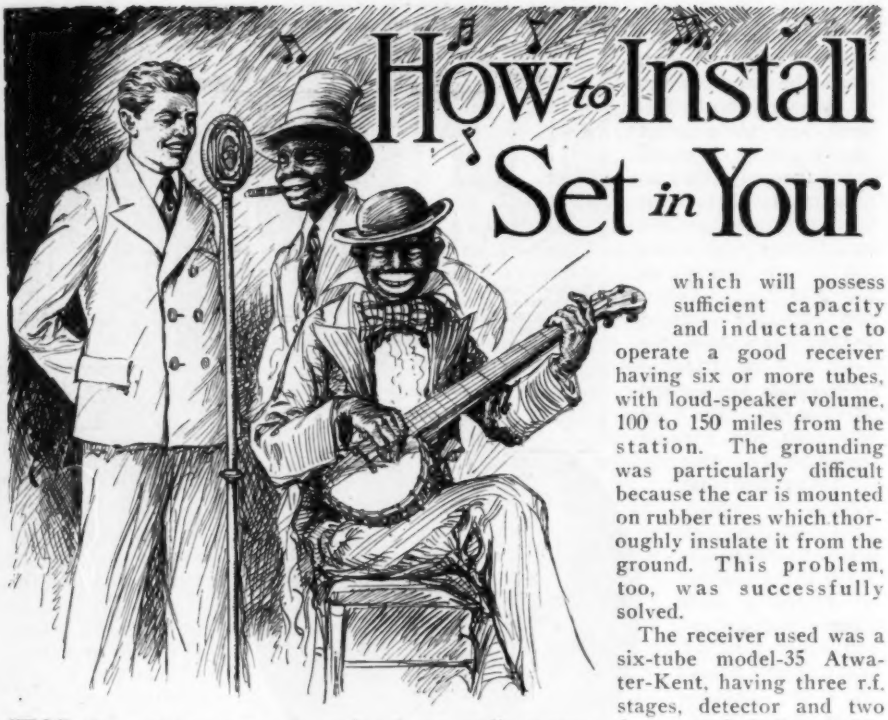
Now stand the assembly bottom up, and tie a piece of wire or stout cord around the bottom to hold it securely together. The can is then completely filled with battery compound, which can be obtained from any battery-service station. It is this hot compound that prevents the use of a hard-rubber panel, as it would cause the panel to bulge or warp. Any compound that may run over the edges of the can is easily removed with a little gasoline.

After soldering the bottom plate in position on the can, drill two or three holes in the flange for mounting, file off all sharp corners and finish with paint or lacquer.

A toggle switch of the 110-volt type may be inserted in one side of the supply line and mounted on the front panel of the receiver. It will then control the entire power supply to the set. The usual voltage-limiting resistances of either fixed or ballast type must be used in the filament circuits to protect the tubes. It is also necessary, of course, to use center-tapped resistors across the various filament-supply leads to balance out any slight hum. These resistors, connected across the line, should be placed as close to the tubes as possible.

Faulty Lightning Arrester Causes Trouble

Every receiving set that employs an outdoor antenna should have a good lightning arrester. An interesting case that recently came to the attention of the writer will probably help others in a similar situation. The owner complained that his set went dead for no apparent reason; the tubes lighted, the batteries were all right, and no loose or broken connections could be found. A final test indicated something wrong with the antenna. The lightning arrester was then examined and found shorted. A new arrester was the remedy.—R. J. Plaisted, Cleveland, Ohio.



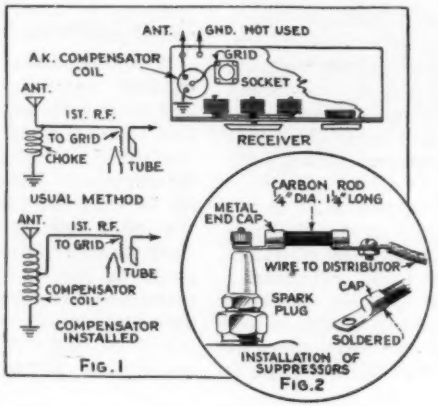
How to Install Set in Your

FOR the past two years the writer has experimented with radio in his automobile and has at last succeeded in installing a set which furnishes pleasure to himself during the day and to the family when out for an evening ride.

The principal difficulties involved were motor-ignition noise and the lack of a good antenna and grounding system. The elimination of motor noise was a rather stubborn problem, but suitable suppressors in the ignition line and proper shielding of the receiver finally accomplished the desired result. The installation of antenna and provision for grounding also were troublesome; however, an antenna may be built in the roof of the car which will possess sufficient capacity and inductance to operate a good receiver having six or more tubes, with loud-speaker volume, 100 to 150 miles from the station. The grounding was particularly difficult because the car is mounted on rubber tires which thoroughly insulate it from the ground. This problem, too, was successfully solved.

The receiver used was a six-tube model-35 Atwater-Kent, having three r.f. stages, detector and two audio stages. Any set of similar design may be used, but it is essential that it be housed in a metal cabinet. The main point to watch in selecting the receiver is, of course, its sensitivity; it must have plenty of r.f. stages to offset the short antenna.

To improve the pick-up of my set, as mounted in the car, an Atwater-Kent compensator coil was installed instead of the choke which is standard equipment. This change is shown in Fig. 1. One terminal is connected to the metal chassis, one to the antenna post and the center one to the grid post of the first r.f. tube socket. A 171-A tube is used in the last audio stage instead of type 112-A.



a Radio Car

by Allen C. Forbes

A binding-post-type cable-connector plug is connected to the cable leading from the set. In this installation, the set was mounted upside down on the floorboard by means of two brackets, as shown in the photos on this page. This mounting may be varied to suit individual needs. One advantage of this form, however, is that the set may be lifted out in a few seconds, since only the lid is fastened to the brackets. A metal plate is cut to fit the bottom of the set and is substituted for the regular bottom plate. With the set upside down, it is best to solder the tubes in their sockets so that they will not bounce out when the car is running, which may happen if the car is not equipped with shock absorbers.

An extra battery box of the Ford, or similar, type is installed in a hole cut in the floor immediately in front of the rear seat, to take the B and C-batteries. The batteries employed by the writer were three No. 10,308 Burgess 45-volt, one 4½-volt C-battery and one 22½ C-battery. The box is supported by the flange at the top, which is screwed flush to the floor and is covered with a removable plate.

About 10 ft. of Belden 7-wire lead-covered cable will be required to lead from the box to the dashboard, where it is brought in as close to the set as possible. Bring the leads from the car battery to the same point in the lead-covered cable and fasten them to one-half of the connector, as in Fig. 3. The plug enables the set to be taken out of the car when necessary. Do not take the negative-A lead to the set from the ignition switch, ammeter or similar point, but directly from the negative terminal on the storage battery.

View of Set from Driver's Seat; Choke Coil Is Screwed to Floorboard at Left of Speaker

Manufacturers invariably ground the positive terminal of the storage battery to the frame of the car; this complicates matters somewhat, as, in the modern receiver, negative-A and negative-B are connected to ground. It will be noted, in Fig. 1, that the ground post of the set is not connected. No ground is necessary, but under no circum-

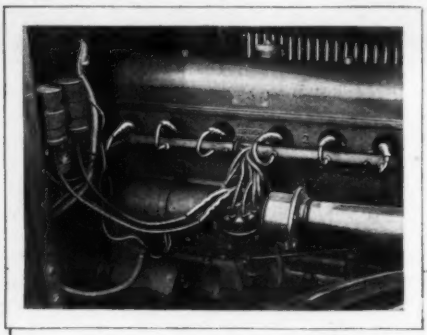
stances must any part of the metal chassis or metal cabinet of the set make contact with the frame of the car, which is positively grounded.

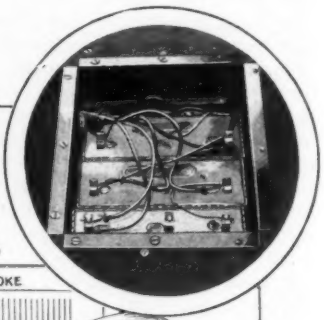
For the antenna, purchase sufficient copper-wire screen of standard width to reach from the rear of the car roof to the front. Cut a hole in the center to fit over the dome light so as not to ground the antenna. The screen may be tacked to the strips supporting the roof, but must not ground to the car frame or lighting wires. Those who wish to hide the screen can have the lining in the roof removed and the screen tacked in place under the cloth, so as not to mar the appearance of the car interior.

A length of No. 16 insulated fixture wire is soldered to the right front corner of the screen and brought down the corner post to the connector plug. No ground connection is necessary, as a counterpoise effect is obtained. In some cars, wire netting is used in the construction of the top, and this must, of course, be removed before the screen is put in. A small cone speaker of the magnetic type, housed in a wooden box, may be mounted at any convenient place in the car. In my case, a Peerless cone was located directly above the set under the instrument board, the dash acting as a good resonator.

The next step is shielding the motor, and the thing that has to be suppressed is the surge or r.f. current, in the secondary side of the coil, and the click in the primary circuit, caused by the making and breaking of contact by the interrupter. There is also a make-and-break click from the relay on the generator.

The primary click of the interrupter and the generator noise are eliminated by means of 1-mfd. 400-volt condensers, as





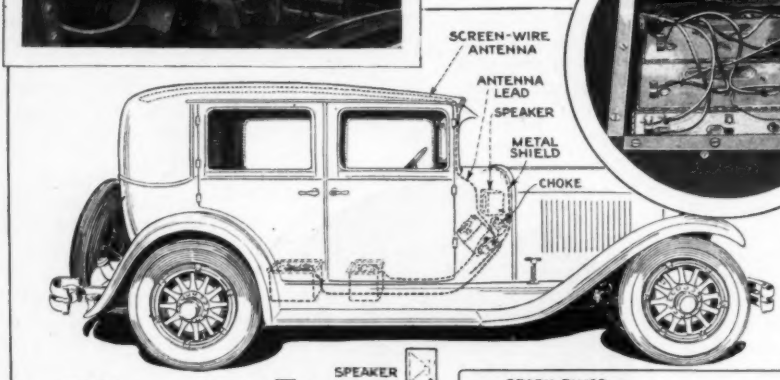


FIG. 3

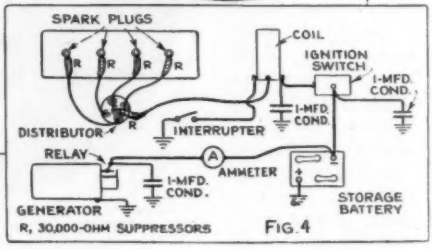


FIG. 4

Upper Left, Suppressors Installed in Six-Cylinder Motor of the Twin-Ignition Type; Right, Container for B and C-Batteries Sunk in Floor of Rear Compartment; Below, Details for Complete Installation

shown in Fig. 4. One condenser is connected across the relay, one side to the battery lead and the other side grounded. Another condenser is connected across the ignition switch on the instrument board of the car, one side to the "live" side of the switch and the other to the ground. The ground referred to is the frame of the car. A condenser of the same size and type is connected on the coil, one connection to the live side of the battery and the other terminal grounded. This takes care of the inductive primary click and the generator noise.

Receiver Mounted on Brackets and Elevated to Provide as Much Foot Room as Possible

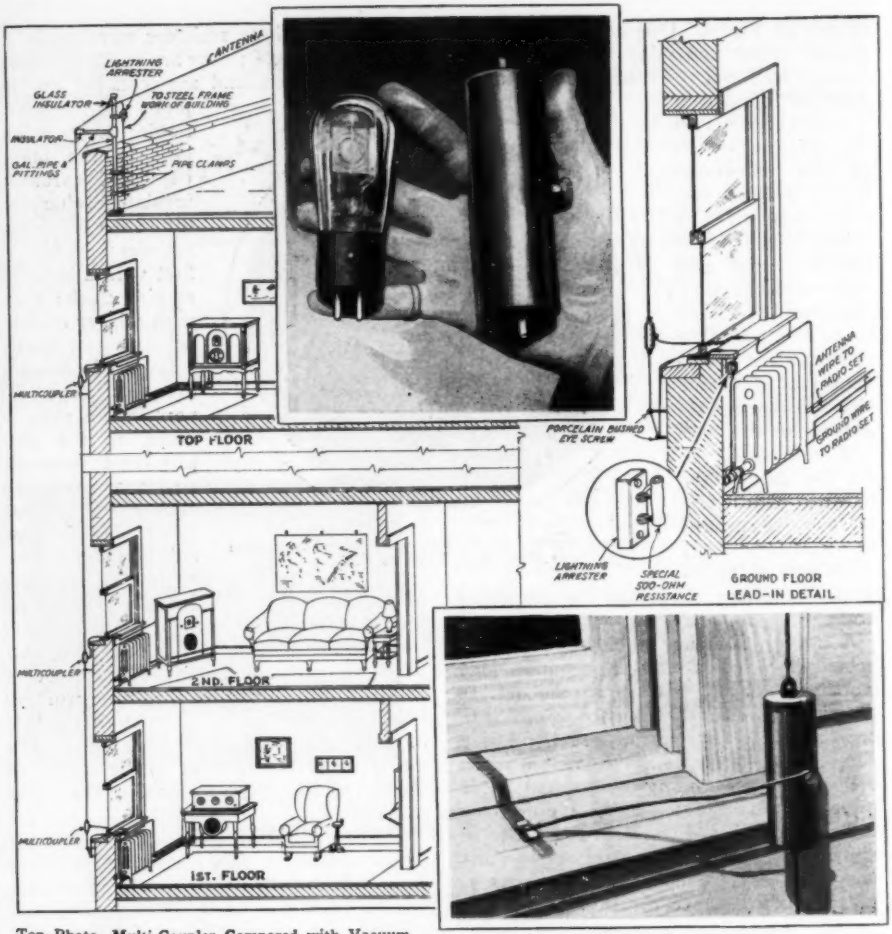
A 2-amp. 50-henry choke coil is connected in series with the negative lead from the storage battery to the set, as shown in Fig. 3. This choke is optional, but its use is advised because there is a difference in the potential available when the motor is running and when it is stopped. A single-pole single-throw switch may be used to shunt the choke in or out as desired. Of course, only 6 volts can be drawn from the storage battery, but, when the generator is charging the battery, the voltage increases to 7½, so the choke is a real protection. In this installation, where six ¼-amp. tubes were employed, the set voltage does not exceed 5½ volts when the battery is charging, with the choke in the line. The choke may remain in the line, as the only time it would be desirable to cut it out is when the car is stationary for a long period. For example, if you are out in the country and want distant reception while standing still, it would be advisable to cut the choke out of the circuit to apply more filament current to the tubes.

The suppression of the oscillating current in the "high" side of the ignition line going to the spark plugs is accomplished by the use of carbon resistors, as shown in Fig. 4. These resistors were made as detailed in Fig. 2; they are of 30,000 ohms' resistance each, and are installed on the plugs as shown. Solder the terminal lugs to the metal caps and carefully insulate each resistor in the following manner: Wrap it first with a layer of empire cloth; then with a layer of rubber tape and finally a layer of ordinary friction tape. If you do not care to make up the carbon-rod resistors, you may try the new Lynch 5-watt 30,000-ohm Veritas resistors, or carborundum resistors of similar type. The resistors should be placed as close to the spark plugs as possible. This is easy, as the metal lug soldered to the end cap of the resistor is drilled to fit directly on the plug terminal. Place one suppressor or carbon resistor in series with each spark plug and one in the ignition line running to the center of the distributor head, as close to the latter as possible.

My car was a 1929 Nash six with twin ignition, and for this system 14 resistors were required, 12 for the spark plugs and one in each coil line. This installation worked out so well that little trouble should be encountered with simpler ignition systems.

If your car has a wooden dash or partition between the motor and the body, it is necessary to shield this partition and ground the shield to the frame. The shield may be made of .0025-in. galvanized iron and should extend from the top of the cowl, down under the floorboards and beyond the set, as shown by the dotted line in the upper sketch in Fig. 3. No shielding is required if the dash is of metal as is commonly the case.

¶Popular Mechanics radio department offers its information service free to all readers of our magazine.



Top Photo, Multi-Coupler Compared with Vacuum Tube; Left, Complete Installation; Right, Lightning Arrester, and, Below, the Coupler Installed, Showing Antenna Lead to Window Strip

Solving the Apartment-House Antenna Problem

A practical antenna system for apartment houses has taxed the ingenuity of radio engineers for a number of years. The latest development along this line, based on a device known as the multi-coupler, is an entirely new arrangement which meets all requirements. The multi-coupler comprises a bakelite case, 6 in. long and 1½ in. in diameter, containing the necessary circuit components. The case has connecting lugs at top and bottom and a binding post on the side. As many as 25 radio sets may be operated on a single or common antenna by means of one multi-coupler for each receiver, but an average of 12 to 15 is followed in practice. Briefly, a common antenna is installed for every 12 or 15 radio sets in the apartment building. The down lead from the antenna, instead of being brought to a single radio set, is run alongside the wall of the building and close to a vertical row of windows as shown in the sketch. The down lead carries a multi-coupler at the level of each floor, or near the window for that floor. The radio set in the apartment is connected to the binding post on the side of the multi-coupler, and the down lead is connected to a lightning ar-

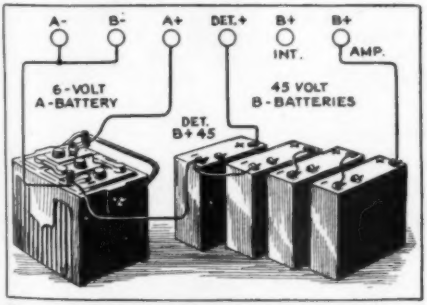
rester with a high resistance shunted across it, so that the antenna system is protected as required by the fire underwriters. The coupler serves as a filter, passing mainly the broadcast frequencies to the receiver. Therefore inductive interference of electric motors and household appliances is reduced to a minimum.

Protecting Insulation on Battery Wires

The ends of radio-battery wires may be dipped in melted paraffin to protect the insulation from the action of the acid. At the same time the clips and terminals on the ends are coated with the paraffin. This prevents corrosion. Remove only enough of the paraffin to insure a good clean contact on the battery terminal.—Robert J. Williams, Chicago, Ill.

Individual B-Battery for Detector Plate

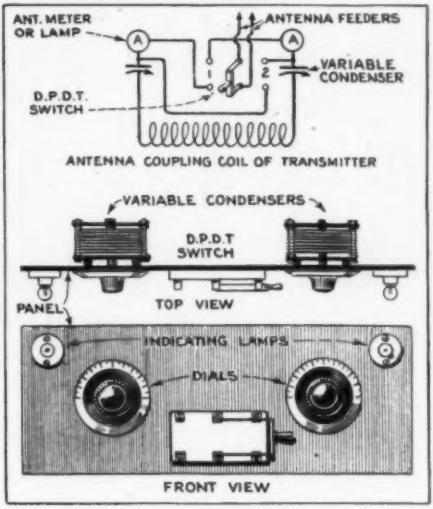
For the prevention of "motorboating" and the successful operation of touchy circuits, there is nothing better than a separate B-supply for the detector plate. The use of the separate unit is not confined to battery-operated sets only, but can be applied to d.c. receivers employing B-eliminators. In some cases, too, quiet operation of a.c. receivers has been obtained by the same method in combination with the power pack. Anyone who has checked B-batteries has noted that the drain on the detector B-battery unit is greater than that of the other units. The tendency of one lower unit is to drag the others down to the same level. The separate B-battery eliminates the harmful resistance set up by this unequal condition.



Suggested Battery Hookup, Showing the Location of the Separate Unit

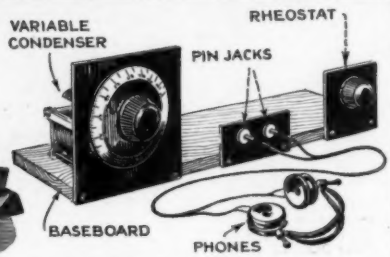
Change-Over Switch for "Zepp" Antenna

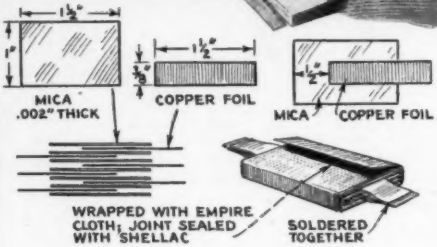
Radio amateurs who are employing the Zeppelin type of antenna for transmitting are sometimes at a loss to cut out the indicating lamps or frequency meters after the wave adjustments have been made. It is annoying to have the lamps flash every time the key is pressed and the swinging of the needle is detrimental to the meters. However, the arrangement shown constitutes a change-over switch that cuts out the indicators when desired and yet enables them to be thrown back into the circuit instantly. This type of antenna is supplied by two feeders, consisting of quarter-wave wires leading from the antenna-coupling coil to the antenna end of the wires; one is connected direct to the antenna and the other, parallel with it, is dead-ended at the antenna with an insulator. The two adjusting condensers and indicators are in series with the feeders, a lamp and a condenser to each one. The indicating lamps are of the flashlight type and the matched variable condensers are placed as far apart as possible. The condenser rotors are connected to the ends of the coupling coil and the stators to the contacts at the ends of the switch and to one side of the lamps.



Front and Top Views of Panel Arrangement, and Diagram of Hookup

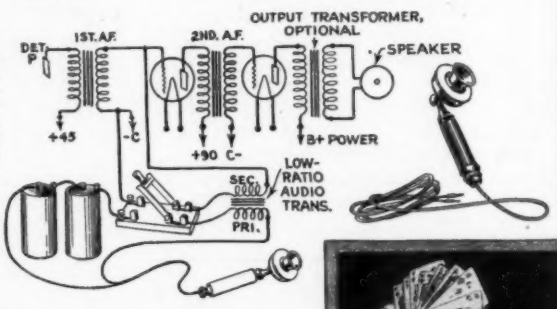
Helpful for Radio

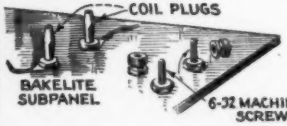




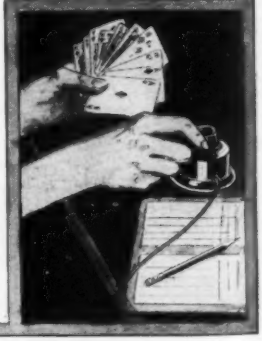
Above, Scrap Pieces of Bakelite Used as Unit Panels for Building Experimental Radio Apparatus; Odd Sizes of Discarded Panel Material May Be Cut to Suit the Builder's Needs and Screwed to a Baseboard as Shown for Mounting Variable Condensers, Phone Jacks, Rheostats and Volume Controls; Semi-Breadboard Layouts of This Type Are Easily Adapted to Any Experimental Hookup; Below, a Simple Method of Connecting a Microphone to a Radio Receiver, so That the Operator Can Broadcast His Own Voice through the Speaker

Above, Homemade Fixed Condensers; Two Copper Plates, Overlapping 13/16 In., Have a Fixed Capacity of .0002 Mfd.; Each Additional Plate Increases Capacity by .0002 Mfd.; Number of Plates Required for Desired Capacity Is Found by Halving Capacity and Adding 1 to Fourth Decimal Place



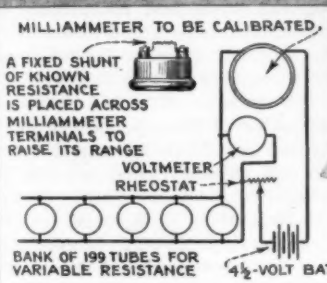


Left, Machine Screws or Standard Coil Plugs Make Handy Mountings for Fixed Circuits, When Several Capacities Must Be Tried



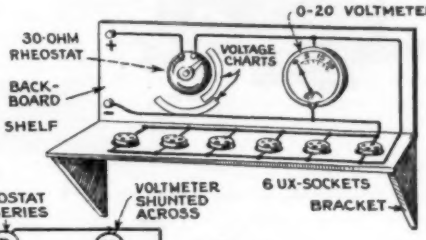
A Table-Type Variable Resistance May Be Used to Control Radio Volume to Suit Any Occasion Where Loud Signals Interfere with Conversation or Temporarily Distract the Attention of a Group at a Card or Dining Table as Shown in the Photo; the Standard Variable Resistor Is Shunted across the Speaker as Shown in the Sketch above the Photo on the Opposite Page; an Extension Speaker Cord May Be Used to Bring the Control to Any Point Desired

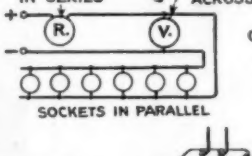
Kinks Fans

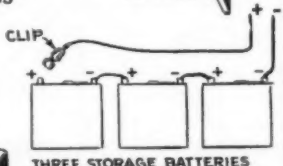

MILLIAMMETER TO BE CALIBRATED
A FIXED SHUNT OF KNOWN RESISTANCE IS PLACED ACROSS MILLIAMMETER TERMINALS TO RAISE ITS RANGE
VOLTMETER
RHEOSTAT
BANK OF 199 TUBES FOR VARIABLE RESISTANCE
4½-VOLT BATT.

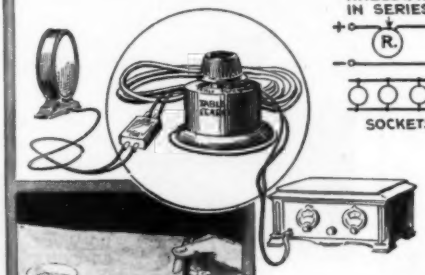
Above, Type-199 Tubes Used to Calibrate a Low-Reading Milliammeter to Indicate a Much Higher Current; Each Tube Requires 60 Milliamp., Thus Two Tubes Will Take 120 Milliamp., and So On; Regulate the Rheostat to 3.3 Volts; if a 300-Mil. Scale Is Desired, Select Shunt Resistance Value So That, with Five Tubes Burning at 3.3 Volts, Milliammeter Pointer Will Just Travel across the Dial; Take Out One Tube at a Time and Mark Dial for Each 60-Mil. Reduction; Higher Readings May Be Obtained by Using 201-A Tubes at 250 Mil. Each and a Higher Shunt Value

Handy Antenna and Ground Connections for the Experimenter; When Used for More Than One Set, Insert a .00025 or .0005-Mfd. Fixed Condenser in Series with the Antenna Lead to Each Receiver









Above, an Inexpensive Tube Booster for the Bench; Up to Six Tubes of Either the 3 or 5-Volt Variety May Be Boosted at Once; Use Only Two Batteries in Series for the Type-199 Tubes; Connect the Negative Battery Lead Permanently; the Positive Lead Is Adjustable by Means of a Spring Clip; Flash the 201-A Tubes at 18 Volts for 20 to 30 Seconds, and Then Age at 7 Volts for 10 Minutes to an Hour, Depending on Condition of Tube; Flash the 199-Tubes at 12 Volts for 10 to 20 Seconds and Age at 4 Volts from 15 Minutes to an Hour; Mark Voltage Adjustments on Rheostat Charts; a Toy Transformer, Variable from 2 to 25 Volts A.C., May Be Used Instead of Batteries If Desired

Building a Capacity Bridge

The need of an instrument for measuring condenser and antenna capacities is frequently felt by the amateur experimenter, but the cost usually discourages him. This, however, need not be the case, for he can build his own at a comparatively limited figure. The capacity bridge illustrated in this article is easily made and will measure small capacities within an accuracy of 5 per cent. It may be used to measure antenna, condenser and wiring capacities, and the results obtained in practice and experiments will be well worth the time and cost involved in its construction. The parts required are: one .0005-mfd. variable condenser; one 50,000-ohm resistor of the gridleak type; one 50,000-ohm variable resistor; one bakelite panel, 5 by 5 by 3/16 in., and the necessary screws and binding posts. These are mounted on the panel as shown in Fig. 1. The circuit arrangement and schematic diagram (Figs. 2 and 3) are so simple that little comment is necessary. The phones are of the 3,000-ohm type. After mounting the parts and completing the wiring, the instrument should be housed in a wooden box with a hinged lid, as shown, and is then ready to be balanced and calibrated. To do this, connect a .0005-mfd. fixed condenser of good grade across the posts marked X. Turn the variable condenser to full capacity, then connect the 110-volt, 60-cycle house-lighting supply to the binding posts designated for this purpose, through a 25-watt lamp. This lamp serves as a protective device, should any of the condensers under test be

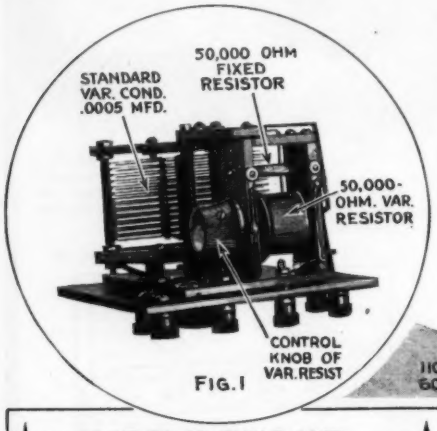


FIG. 1

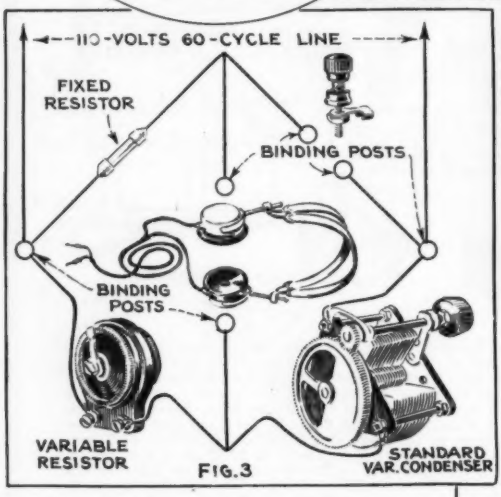


FIG. 3

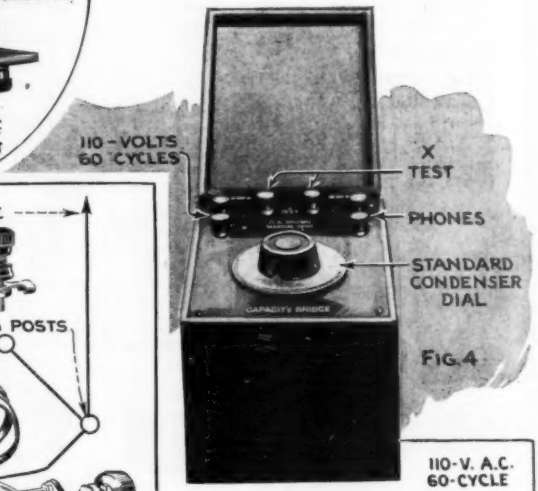


FIG. 4

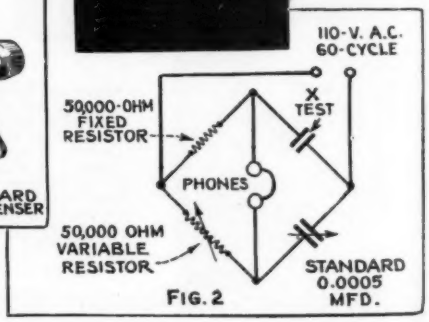
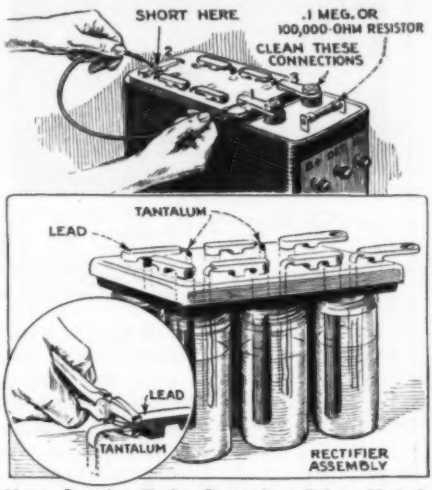


FIG. 2

shorted. Merely connect the lamp in series with one side of the 110-volt line. Now, with the phones connected, you will hear the 60-cycle hum of the line voltage and by turning the variable resistor in, the hum will gradually diminish. By close listening, you will be able to establish the point where the hum fades out entirely. This is where the circuit is balanced, and the resistor should be secured permanently at this setting. Care should be taken in doing this, to make sure the resistor does not move, as a deviation on either side of the balance point will again introduce the hum. To measure an unknown capacity, remove the .0005-mfd. fixed condenser from across the posts marked X, and substitute for it the unknown capacity. Now, with the bridge connected to the lighting current, turn the variable condenser until the hum in the receiver is at a minimum. Note the condenser dial reading at this setting. When the variable condenser is "all in," and the dial reads 100, this corresponds to a capacity of .0005 mfd. across posts X. As the condenser scale reads uniformly throughout, this means that a reading of 50 on the dial would indicate a value of .00025 mfd. for the unknown capacity. A reading of 25 on the dial indicates a value of .000125, and so on, each point on the dial indicating .000005 mfd. This instrument can be used only to measure capacities within the limits of the capacity of the standard variable condenser. If a higher range is desired, the experimenter can build another unit employing the same resistor values but substituting a variable condenser of higher value.—D. A. Brown, Marion, Ohio.

First Aid for the Electrolytic B-Eliminator

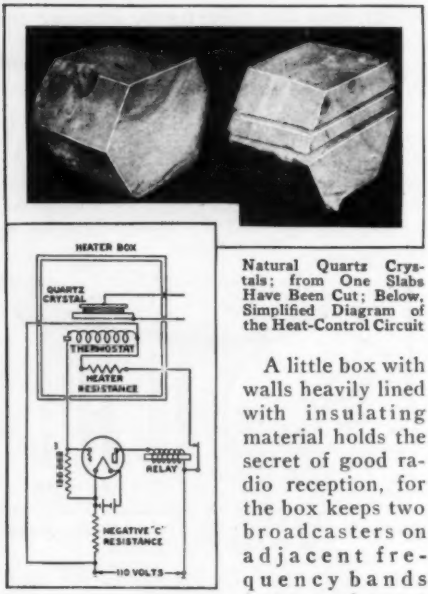
When the electrolytic B-eliminator quits, there are several kinks that the owner may resort to before throwing it away or ordering new parts. First remove the rectifier assembly and clean the brass screws with sandpaper. In case the threads in the nuts are stripped, replace them with brass nuts taken from old dry cells, being careful that they do not make contact with the iron cover when it is in place. Be sure the liquid covers the electrodes. If there is much sediment and the output voltage is below normal, empty the cells by unscrewing them from the rubber cap, dumping the



Above, Locating Faulty Connection; Below, Method of Correcting Faulty Joint

old solution and rinsing under the cold-water faucet, then filling them with new electrolyte furnished by the manufacturers. Do not use ordinary storage-battery electrolyte. The tantalum electrodes are cast into the lead connectors and sometimes become corroded, causing poor contact. Solder will not take hold on either the tantalum or the lead, but all that is necessary to re-establish contact is to squeeze the lead with a pair of pliers. The faulty joint may be quickly found by turning on the set and the current on the eliminator, then shorting the cells one at a time or, better still, three at once by touching the ends of a wire to points 1 and 2 then to points 2 and 3. With the load on, the weak connection usually reveals itself by sputtering, sparking or by a tiny column of smoke. Squeezing here with pliers will bring in the music with old-time vigor, provided the A-battery, tubes and set are in good condition. If you have changed over to a soft detector since connecting up the B-power, it might be well to substitute a 50,000-ohm resistor for the 100,000-ohm one that was in the eliminator originally. This will raise the detector voltage from 22 to 45 volts.

Heat in Insulated Box Makes Radio Trouble-Free



Natural Quartz Crystals; from One Slabs Have Been Cut; Below, Simplified Diagram of the Heat-Control Circuit

A little box with walls heavily lined with insulating material holds the secret of good radio reception, for the box keeps two broadcasters on adjacent frequency bands from straying out of their own territory and interfering with each other. The radio expert says a piezo-electric oscillator, made of a piece of quartz, does the work, but it is the heated, cold-proof box that keeps the crystal on the job. The rock crystal, or quartz, which is used to keep the carrier wave of the radio broadcast station oscillating at a constant frequency is cut from a larger crystal slab, which, in its original form, was hexagonal. The crystal is first cut off in six-sided sections about 1¼ in. long, and then a slab is cut out near its center, with one surface parallel to the plane formed by two opposite corners of the hexagon. After cutting, the slab is trimmed to a square, and then ground to the proper thickness, or as nearly as that can be approached. It is the thickness that controls the rate of vibration. As no crystal can be accurately ground to oscillate at an exact frequency, the heated box is the final solution, for the thickness of the crystals varies with their temperature. The grinders cut the quartz down until it has the correct thickness for some temperature between 50 and 70° C. It is then mounted between two metal plates in the insulated box, and a small heating coil and thermostat are placed below it. The thermostat is so sensitive that it cannot control the heater current directly, but operates through a vacuum tube, which in turn controls a relay. In actual operation, the heater is turned on and off about once a minute, and the temperature remains so constant that the broadcast frequency never varies more than a very few cycles.

Neon Lamp as a Test Device

A neon lamp of the 110-volt type may be connected to the power lines with a pair of test prongs to make a fine continuity tester for the various parts of a radio receiver. The bulb will light in a circuit having a resistance of 1 meg. or more, yet will not be damaged on short circuit. It may be used to estimate the impedance of choke coils, transformer windings, the capacitance of condensers above .002 mfd., the value of resistors and even for short-circuited turns in audio transformers.

Speaker Employs Corner Baffle

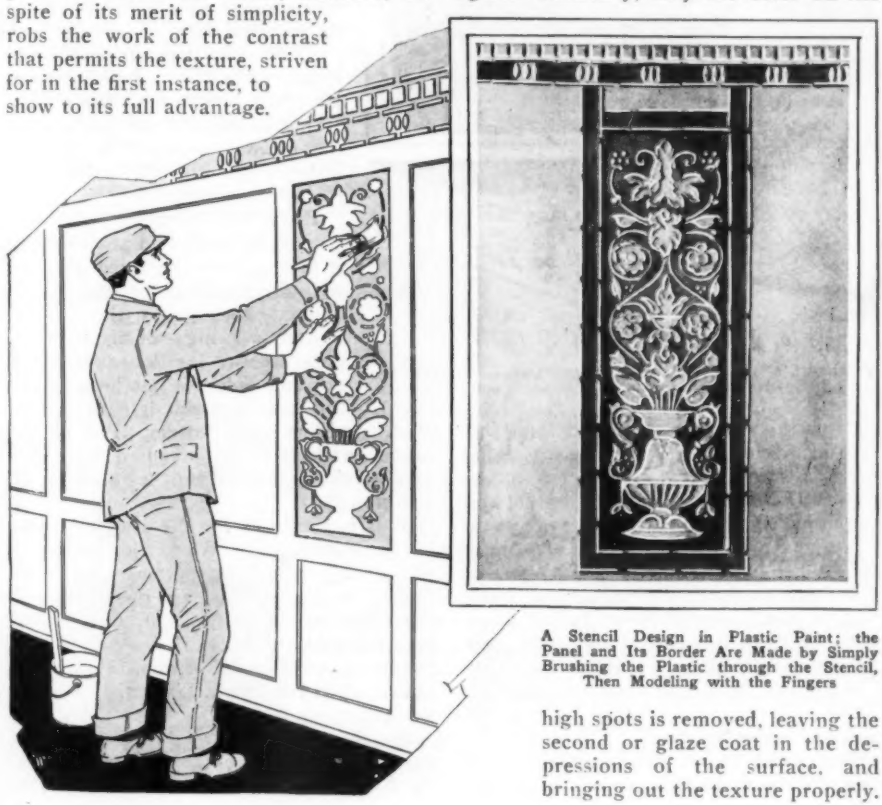
One of the new speakers recently exhibited at the radio shows employs an ornamental wood shield which may be hung in any corner of a room, with the result that the walls direct the sound toward the center. The walls of the room reflect the sound as a mirror reflects light, to a degree depending on the material in which they are finished. The speaker is available in both dynamic and magnetic types, and is finished in walnut which will harmonize with any interior.

Relief Decorations with Stencils

By J. S. HAGANS

THE decoration of relief-textured walls, panels, etc., sometimes presents a problem to the novice. The simplest form of decoration is, of course, the application of a coat of color in the form of a glaze, paint or calcimine. This, however, in spite of its merit of simplicity, robs the work of the contrast that permits the texture, striven for in the first instance, to show to its full advantage.

One alternative is to apply an undercoating of the desired background color and allow it to dry. Over this, a coat of some contrasting or harmonizing color is applied, and, while still wet, wiped off again. Naturally, only the color on the high spots is removed, leaving the second or glaze coat in the depressions of the surface, and bringing out the texture properly.



A Stencil Design in Plastic Paint; the Panel and Its Border Are Made by Simply Brushing the Plastic through the Stencil, Then Modeling with the Fingers

A Close-Up of a Modeled Stencil Design; Designs like This Are Easy to Reproduce with Plastic Paint

Often this is not enough, and some further decoration is desired. The first thing usually thought of is stenciling, but in this, even at its best, there is something flat and commonplace when used in connection with a textured surface. It is also quite a job to get a clean-cut effect with a stencil on a rough surface. There is a way, however, to use a stencil so as to get away from the flat effect and at the same time eliminate the trouble in application. This is to employ the plastic used for texturing of the wall as a "paint," thus leaving the stenciled design in relief.

Most paint stores carry stencils in a wide variety of designs, or can refer the home decorator to a source of supply. Where a special design is wanted, as for a panel, it is easy to make your own. This is done simply by taking a suitable design from some advertising illustration and enlarging or reducing it by means of a pantograph onto some stencil paper. In the absence of such paper, light bristol board will do, but be sure to coat both sides of the board with linseed oil and let it dry before using it.

Making your own stencils has this advantage: You can pick any design you like and can make it any size. Also, by using linoleum or similar thick material as a stencil, the height of the relief can be increased, as, naturally, a stencil cut from such material leaves the design standing out more boldly than a stencil about 1/32 in. thick does.

All that is necessary now is a supply of textone, or similar plastic, and a paintbrush. The plastic, which comes in the form of a dry powder, is mixed to the consistency of a thick paste with lukewarm water.

Place the stencil on the surface to be decorated and, holding it firmly, draw the brush charged with the plastic across the design. There is no need for the care required in using stencils with ordinary paint, for the textone will not run unless it has been mixed too thin, and this is easily remedied by adding more powder. Pull off the stencil, and the design stands out in relief to a height depending on the thickness of the stencil.

This is the basis for the simplest form of the decoration. When the stencil is pulled off, it will be noticed that little "nibs," or projections, are raised around the edges of the design. Do not bother about these until the work has completely hardened, which takes from six to eight hours; then rub them down with a bit of sandpaper.

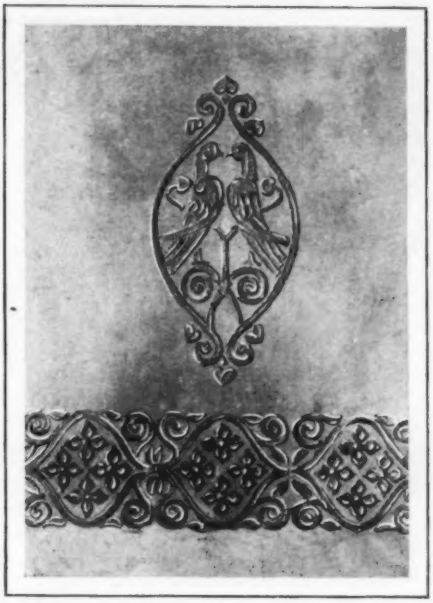
For those who want something a little more realistic and exhibiting more of a hand-tooled effect, the plastic lends itself

admirably to all sorts of modeling and manipulation while still soft. In the panel shown on page 135, for example, the petals of the flowers were modeled with the ball of the thumb, and the flutes in the urn with a simple wooden tool. This gets away entirely from the flat effect. Light sanding when the work has dried is generally desirable, though not essential.

In the example on page 136, it will be noticed that the mid ribs on the leaves have been brought out in relief. This is done with a pointing tool, or with a piece of cardboard, drawn from the outside of the leaf toward the center and pulling the plastic with it. The modeling in the stalks and elsewhere has been done with the finger tips. The diamond background was formed on the original wall coating, using a straightedge to score the diamonds. The stars and plant forms were then added with the stencil.

In the example on this page is illustrated a plain stencil and a hand-modeled effect. The frieze in the lower part of the photo was done with the stencil and left flat. The medallion above was stenciled and then modeled with the fingers to accentuate the effect.

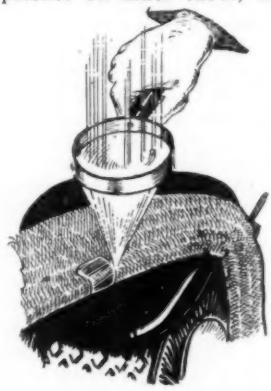
Color, of course, can be used on the relief decoration to an extent limited only by the artistic skill of the decorator. The amateur should not use bright or strong colors, but rather tints, keeping the color effect somewhat subdued, especially if the design is a large one. The colors, of course, can be brighter where the design is small and unobtrusive.



In This Example the Frieze or Border Is Left Flat, and the Medallion Modeled with the Fingers

Reading Glass Facilitates Removal of Inner-Tube Patches

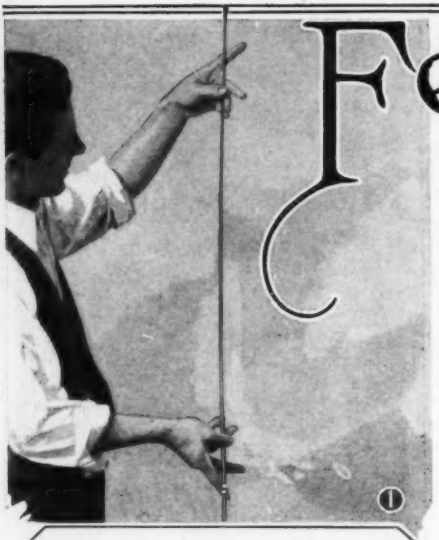
It is sometimes desired to remove old patches on inner tubes, as, for instance, when a new leak is found next to the patch. A good method of removing the patch is to heat it by focusing the sunlight on it with a magnifying glass. This will soften the cement, and make it easy to remove the patch. Care should be taken not to burn the rubber, which may result if the heat is directed on one spot too long. Start on the edges and, as soon as these are loosened, play the heat back and forth until the rest of the patch comes off with a slight pull.—Luther Strosnider, Onaga, Kans.



Hammock Carrier in the Car

Small hammocks, of the kind used in Pullman berths, will be found useful in the auto during long trips for holding numerous articles that are needed from time to time. This will avoid the trouble consequent upon keeping such articles in suitcases, which have to be opened and closed each time something is wanted, and also eliminates cluttering up the seats or floor with them.—Harold E. Benson, Denver, Colo.

Fencing is



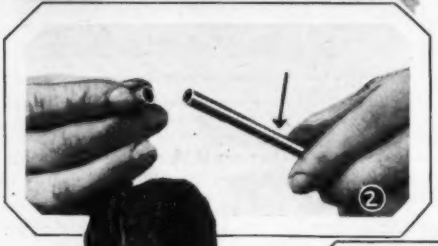


Fig. 1, the Potential Foil; Fig. 2, Slipping the Collar over the Rod; Fig. 3, Fitting the Guard, and Fig. 4, the Guard Lining

IT'S a far cry from the harmless fishing rod of today to the flashing steel blade of a dashing D'Artagnan of yore. Nevertheless, the average steel fishing rod can be made into an excellent fencing iron, a foil with every bit of the snap of the expensive hand-forged weapon, which will give you plenty of keen, tingling sport while developing your eyes and co-ordinating your muscles.

Spend a dollar. Buy one of those 4½-ft. jointed steel fishing rods which are offered by any of America's large department stores. With a hacksaw, cut off 37½ in. of this. By heating the rod slightly, you can easily melt the solder and remove the intermediate guide eyes. The tip-end guide eye should be left in place. Do not remove the reinforcing rings from the joints; merely file these down lightly all around, in order to take off the sharp edge.

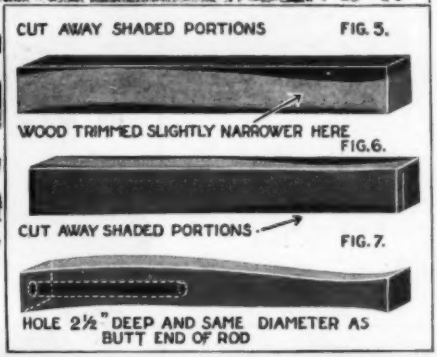
Your potential foil will then appear as in Fig. 1. Now, cut off a ½-in. piece from the next larger section of steel tubing, and slip this over the butt end of your rod, as in Fig. 2, running it up to the position indicated by the arrow. Solder it firmly in place. Get an old gong from a large bell. Flatten it out slightly. Enlarge the hole in the center to the exact size of the butt end of your rod, and then slip the bell into place, as shown in Fig. 3, pushing it along the rod until it is stopped by the metal collar. Cut a round disk of heavy, yet pliable leather, which will fit snugly inside the gong, as in Fig. 4.

All ready for the handle; this, by the way, is a

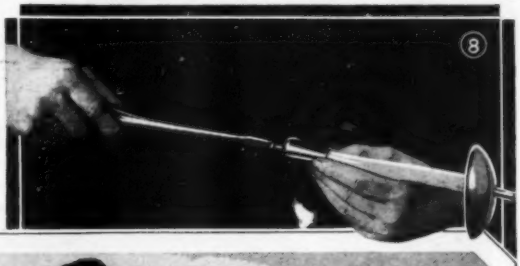
Great Sport

by Sam Brown

fairly tricky piece of workmanship in that it must be cut just so in order to fit the natural curve of the hand. Almost any wood will do. Get a smooth, straight-grained piece, 6¼ in. long by ¾ in. square, and whittle down two of the sides until the piece takes on the shape shown in Fig. 5. Notice how the stick curves slightly; also that, at one part of the curve, the wood is trimmed a trifle narrower than elsewhere. Trim the two remaining sides to the shape shown in Fig. 6, and round off the corners.


CUT AWAY SHADED PORTIONS
FIG. 5.
WOOD TRIMMED SLIGHTLY NARROWER HERE
FIG. 6.
CUT AWAY SHADED PORTIONS
FIG. 7.
HOLE 2½" DEEP AND SAME DIAMETER AS BUTT END OF ROD

The next operation is the drilling of a hole in the end of the handle, using a drill the same size as the butt end of your fishing rod, and making the hole 2½ in. deep, as in Fig. 7. Swab this hole lightly with glue, and then fit the handle onto the end of the rod, pressing it snugly into position, as shown in Fig. 8.



Every good fencing iron must balance at a point 1 in. from the guard, as in Fig. 9, so it becomes obvious that a weight of some kind must be attached to the butt end of the handle. You can weigh the handle with buckshot, bore a hole and insert a heavy

Fig 10, Fitting the Tip, a Rubber Eraser, to the Foil with Glue and Tape; Fig. 11, Showing the Handle Wrapping and Also How the Foil Should Be Held

In Fig. 12 the Fencer Is on Guard; in Fig. 13 He Has Just Completed a Thrust

Fig. 14 Illustrates the Lunge; Note Carefully the Positions of Hands and Feet

Fig. 14 Illustrates the Direct Lunge, and Fig. 15 Lunging at a Target

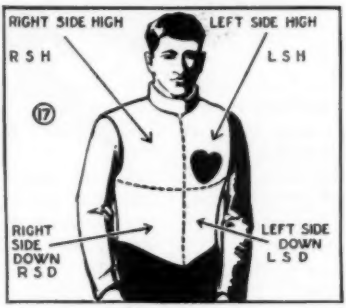
iron bolt, or mold or turn a knoblike piece from brass or lead, which can be screwed into position, as shown in Fig. 8. At any rate, get the weight. The finishing touches consist in taping the handle with adhesive tape, Fig. 10, and gluing and taping a "slip-over" pencil-eraser tip to the end of the foil, as in Fig. 11. You can remove the paint from the rod if desired, making it, in truth, a flashing blade.

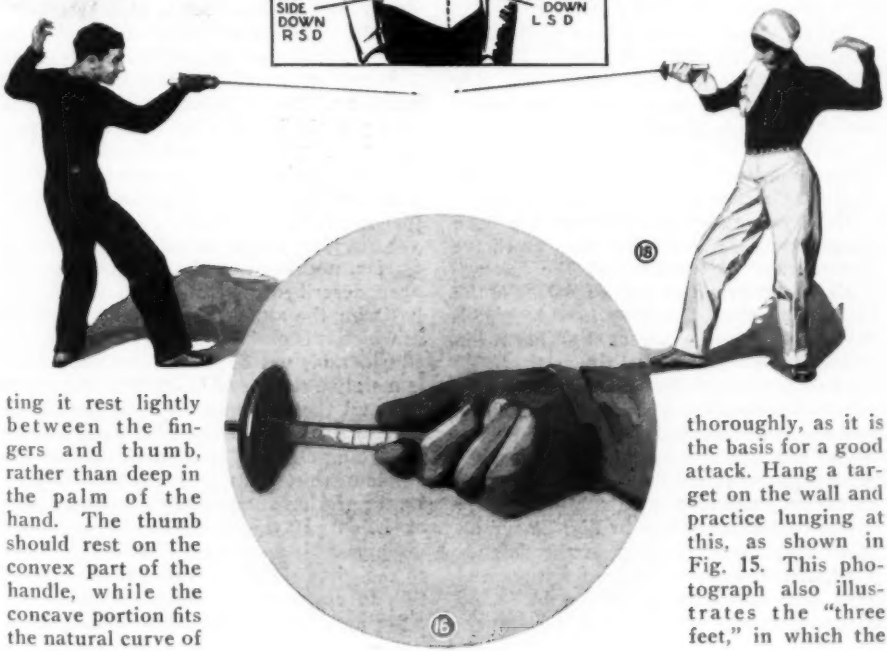
The next item is the mask. This may be an old baseball catchers' mask, neatly covered with fine-mesh hardware cloth. Of course, you can fence without a mask, but it's risky business, although it usually ends happily.

The rest of your equipment will consist of a gauntlet-type glove for your fencing hand, and a pair of rubber-soled shoes. You can make a very elaborate fencing raiment if you wish, but a heavy sweater and everyday trousers will do nicely.

Now for some practice: Hold the foil as shown in Fig. 11, letting it rest lightly between the fingers and thumb, rather than deep in the palm of the hand. The thumb should rest on the convex part of the handle, while the concave portion fits the natural curve of the hand. Assume the position shown in Fig. 12, which is known as "on guard," feet well apart, elbows slightly out from the body, the entire weight of the body on the left leg. From this position, extend the right arm quickly, so that the arm, wrist and hand will form a straight line with the foil, the foil being on a line with the shoulder, as in Fig. 13. This is the "thrust." Practice it thoroughly.

After perfecting the thrust, you can go a step further and learn that all-important maneuver, the "lunge." To perform this movement, do the thrust, and immediately afterward, straighten the left leg, and throw the right foot forward. The right arm should be perfectly straight. The left arm, with hand held palm upward, is likewise straight and parallel with the left leg, as in Fig. 14. Keep the left foot almost perfectly flat on the floor. By pushing back strongly with the right leg you can return to the on-guard position. The lunge should be practiced thoroughly, as it is the basis for a good attack. Hang a target on the wall and practice lunging at this, as shown in Fig. 15. This photograph also illustrates the "three feet," in which the



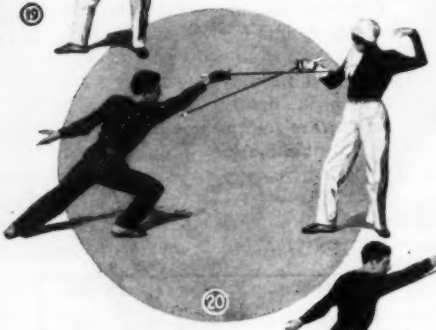


first and second fingers of the free hand rest on the floor to enable additional reach through better balance. The foil may be held at the extreme end, as shown in Fig. 16, if you find difficulty in reaching your man.

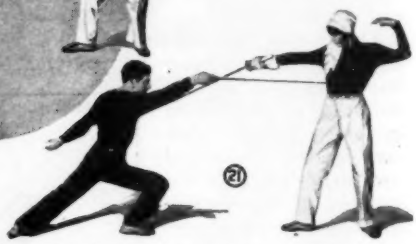
After you have acquired a fairly good technique with the thrust and the lunge, you can try your hand at routine fencing. The idea is this: Your opponent makes known to you where he intends to strike; you, in turn, prepare to ward off his lunge. The same lunge should be repeated over and over, each man alternating.

These lunges can be at any of the four sections of the body, shown in Fig. 17. These sections we will label "left side high," "right side high," "left side down," and "right side down," as shown. The professional fencer has other names for these zones, but they tend to confuse the beginner, and hence are not used here.

Now, you and your opponent are both on guard as shown in Fig. 18. You have agreed that the attack and the "parry" shall be concerned with the LSD. So, the attacking party—the man in this case—uses the direct lunge, as has been explained, and attempts to touch the LSD portion of the girl's body. She parries the thrust by describing a small semicircle downward and toward the left with the tip of her foil, at the same time carrying her hand slightly toward the right, just enough to throw aside the man's blade, which passes under her foil, as in Fig. 19. In all parries, the heavy portion of the defending blade should be opposed against the light portion of the attacking blade, so that a light tap will be all that is necessary to turn the attacking blade aside. Repeat this "get-set-and-go" maneuver several times until both fencers can easily parry a lunge at LSD. In a similar manner, a lunge at RSD is parried by semicircling to the right, the foil hand at the same time being carried slightly to the left.



Lunges in the high zones, that is LSH and RSH, are parried by simply moving the hand to the left or right, depending upon which



side the lunge is on. For example, a lunge at RSH would be parried by moving your hand toward the right until the heavy part of your blade encounters the "foible," or weaker part, of your opponent's foil, throwing it aside.

Parrying sounds rather complicated in print, but a few practice sessions will soon give you the hang of it. The simple parries, as described, are sufficient to ward off any attack, but for the sake of variety you should perfect various other parries of your own.

Now, for some attacking maneuvers. So far, nothing but the direct lunge has been described, and although this is the basis for the attack, there are many ways in which it is practiced. You should make considerable use of the "disengage." This is merely a matter of lunging in one quarter, and then, finding yourself parried in that zone, lifting or lowering your foil tip and going at some new point. As an example of this, you will notice that, in Fig. 19, the girl has successfully parried a lunge at LSD. If the man, however, should disengage his point and whirl it in a circle to the girl's right, he would be in a position to complete his lunge and score on RSH as shown in Fig. 20. Disengaging

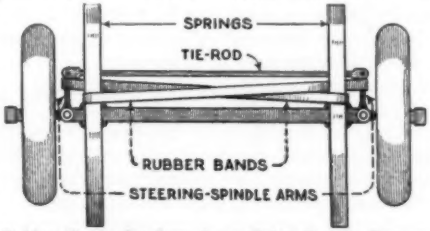
from high lines to low lines is performed by merely dropping the point of your foil, and from low lines to high by raising it.

Learn the "riposte." This is a secondary form of attack, that is, it is one which you undertake when your adversary has attacked and failed to hit. Look at Fig. 21. Here the man has lunged at RSD. The girl has successfully parried the lunge, and, immediately the man's point is past her body, she disengages her foil and delivers a thrust to score in RSH. Ordinarily, in a lunge, the lunger is slightly out of balance and it requires a brief fraction of a second for him to jump back on guard. It is in this moment of off-balance that you must riposte. It is not necessary that you move your body, as your opponent, being at the end of his lunge, is very near to you, and in moving forward you will only overreach yourself and possibly cause your riposte to fly wide.

Naturally enough, the little fencing lesson given in this article does not cover the whole range of fencing tactics. Enough has been given, however, to allow your engaging an opponent in friendly play. Wherever possible, these bouts should be done within an area 20 ft. long by 3 ft. wide. Never fail to acknowledge when you are honestly hit, calling out in such a case, "touch!" If you are hit anywhere outside the zones shown in Fig. 17, you should call out, "on the mask!" or "on the arm!" etc. Such hits, although they do not count in scoring, stop the bout until both combatants have crossed blades again on guard. The regulation bout consists of five points, so that the person first scoring three wins the bout.

Repair for Torn Shoe Linings

Torn shoe linings often shorten the life of an otherwise good pair of shoes. If noticed in time, such tears can be effectually mended with a small strip of adhesive tape. Unless the feet perspire excessively such a patch will last for many weeks and can be renewed if it comes off.



Rubber Bands Cut from Inner Tubes Provide Temporary Remedy for Shimmying Wheels

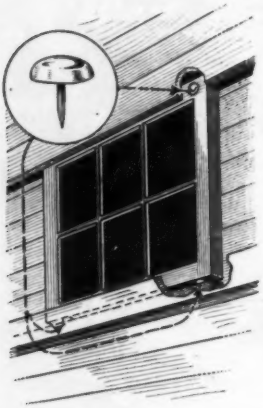
Golf Tees from Envelope Tips

When cut out and folded properly, the corners of envelopes make good golf tees. After the corners are cut off as shown in the drawing, they should be folded in the center to form a pyramid. The top provides a cup in which the golf ball is placed.—Louis Andrews, St. Louis, Mo.

Rubber Bands Prevent Car from Shimmying

Shimmying of the front wheels of a car, which is both annoying and dangerous, can be temporarily remedied by stretching rubber bands, cut from old inner tubes, from the spring on one side to the steering-spindle arm on the opposite side, as shown in the drawing. Such bands will not only prevent shimmying but, if they are of equal tension, will tend to hold the front wheels in alinement with the rear wheels, making it much easier to steer the car. However, the fault should be permanently remedied by providing new bushings for the spindle bolts and adjusting the tie-rod connections and the wheel bearings.

Reducing Friction of Sliding Windows



In building sliding windows for a summer camp and for my garage, I have used the illustrated method of reducing the friction. So-called silence domes for furniture, which can be purchased at any hardware store, are tacked on the edges of the window sash where contact is made with the slides. Care should be taken, however, that the domes do not bind, owing to insufficient clearance between the slide and the sash.—C. C. Fisher, Nashville, Tenn.

Manifold Heater Aids Starting in Winter

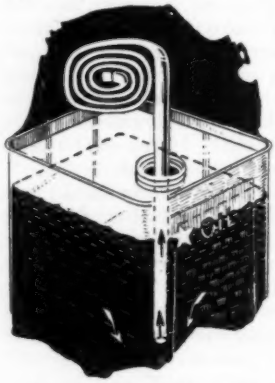
A hot spot on the intake manifold of your car is of great help in starting during cold weather. An electric heater for this purpose may be assembled as follows: Obtain an ordinary 6-ohm rheostat from the radio store, or from the junk box if you are a radio fan. Dismantle the rheostat, keeping the resistance wire intact on its supporting semicircle of fiber. Wrap the intake manifold, just above the carburetor, with several layers of asbestos tape, which may be obtained at the electrical-supply store. Place the fiber, carrying the resistance wire, over the tape, and then cover it with several additional layers of asbestos, after securely twisting a lead wire around each end of the resistance. Bind the whole in place with a turn of heavy wire at each end of the wrapping. The lead wires from the resistance are connected, through a switch, to the battery of the car. If the full 6 ohms' resistance does not pass sufficient current to give good heat, remove the lead wire from one end of the resistor and twist it about the center section, so as to cut down the resistance value. With the latter arrangement and a 6-volt battery, the writer has obtained a temperature of 130° in a few minutes.—H. M. Payne, Cleveland, Ohio.

Method of Coloring Cement

To mix any coloring matter in cement, add a small quantity of water, then some sand and all the color. Mix well and then throw in the rest of the batch of sand and cement, which must all be mixed thoroughly. This method will prevent many troubles in coloring, and there will be no spots. Colors should be mixed in the following quantities per bag of cement: tile red, 7 to 11 lb., Mexican red, 6 to 10 lb., Japanese black, 4 to 6 lb., Persian yellow, 10 to 14 lb., and Alaska brown, 10 to 14 lb.—L. H. Georger, Buffalo, N. Y.

Simple Way of Starting a Siphon

Sucking on a rubber tube to start a siphon in the gas tank is often an unpleasant job. A much better method is shown in the drawing. Insert a small wooden plug in one end of the tubing and then roll up that end tightly, as shown. This forces the air partly out of the tube. Insert the open end in the gas tank, unroll the coiled end, withdraw the plug and the liquid will begin to flow, provided the unplugged end is first brought below the upper level of the fluid in the tank.



Intensifier for Negatives

Amateur photographers are more likely to underexpose their negatives than to overexpose them, with the result that they are thin and weak. Where the trouble is extreme and cannot be remedied by applying the usual methods, the following inten-

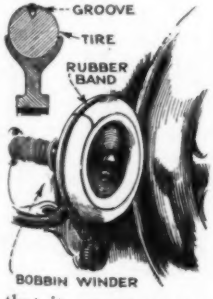
sifier will be found useful and may save an otherwise worthless negative. Dissolve 100 gr. of copper sulphate in 1 oz. of hot water. In another container make a solution of potassium bromide, 100 gr., in hot water, 1 oz. After both solutions have been thoroughly stirred separately, mix them and let cool. Bleach the negative in the composite solution and wash carefully. Then immerse it in a solution of silver nitrate, 45 gr., and water, 1 oz. After the negative has been sufficiently blackened, remove it and wash thoroughly. If, when printing, it is desired further to intensify the negative, this can be accomplished to some extent by placing it in fresh developer for a few moments and then washing again and drying.—L. B. Robbins, Harwich, Mass.

Keep the Armor Dead

When using armored lighting wire around the automobile, care should be taken to strip the armor far enough back from the terminal so that there is no possibility of the armor itself coming in contact with the source of current. If the armor touches the terminals of a switch, lighting connection or other source of current, it will short-circuit to the frame of the car. This may cause dangerous sparking, or even cause the wire to heat enough to start a fire.

Repairing Bobbin Winder of Sewing Machine

After breaking the rubber tire on his sewing-machine bobbin winder, a tailor made a quick emergency repair in the following way: A groove was cut around the periphery of the tire and a light elastic band wrapped around the tire in the groove as shown. This repair proved so satisfactory that it was unnecessary to obtain a new tire for the winder.—W. Edward White, Plymouth, N. H.



Ordinary C-Clamp and Mousetrap Arranged to Hold Fish Securely While Scaling Them

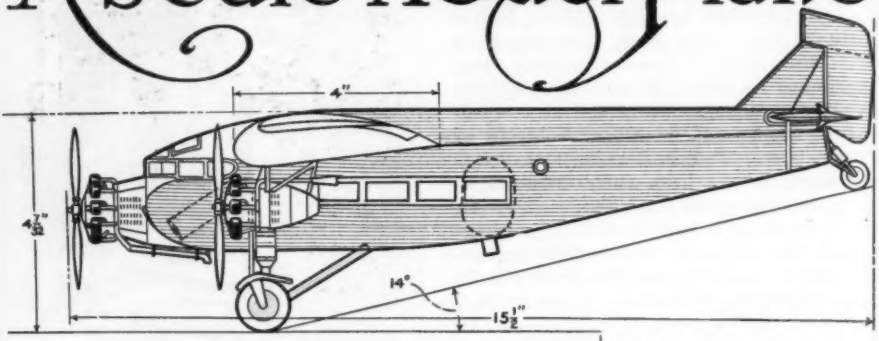
Easy Method of Scaling Fish

For keeping a fish from slipping while it is being scaled, the illustrated method is hard to beat. A few sharp-pointed nails are driven through the base of an ordinary mousetrap so that the points project at the top sufficiently to hold the fish's tail securely when it is pushed over them. The snap spring also helps this action. A C-clamp is used to hold the trap on the table.—Miss Durfe Rockwell, Hollywood, California.

Preserving Specimens of Butterflies and Other Insects

Specimens of beetles, butterflies, rare plants, etc., can be preserved indefinitely by the following process: Arrange the insect or plant in a natural position on a blank developed kodak film. Place another film directly over it and fasten both together with small paper clips. Then place a heavy weight on them until the specimen has entirely dried out. The celluloid of the film possesses preservative qualities, and its odor of camphor prevents insects from attacking it. Specimens so treated will remain in perfect condition for years.—R. C. Radcliffe, Laurel, Md.

A Scale-Model Plane



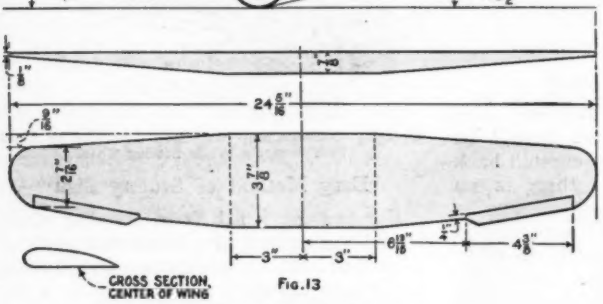


Fig. 13

By WALTER BULLOCK

Pilot, Northwest Airways, Inc.

WITH the wooden fuselage parts assembled, you are now ready to make the wooden base for the wing, streamline tail surfaces and ailerons, and to cover wing, fuselage and tail with corrugated metal.

The wing looks difficult, but isn't, when you analyze its lines. Full dimensions are given in Fig. 13. You will need, for the wing, a block of white pine ⅞ by 3⅜ by 24⅝ in. The top surface is straight throughout its length, all the taper to the wing tips being cut on the bottom side. The bottom, on the other hand, is flat throughout its width, all the streamline curve being on the top surface. And, finally, the center 6 in. has parallel front and rear edges, as well as parallel top and bottom sides, which is of importance when you get ready to apply the metal covering.

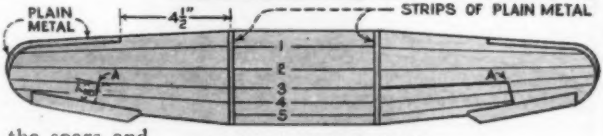
Lay out the top surface of your board and saw it out to shape, except for the aileron slots, which are left to the last to avoid breaking the wing tips. Next turn the board on edge and mark the wing taper on each side, starting 3 in. from the center line, and tapering to ⅛ in. at the ends. Plane down to the taper line, and shape the rounded leading edge. The cross section shows this to be practically a half circle, of a diameter equal to the thickness of the wing. It maintains this form throughout the length of the leading edge, so rounding it down is a simple task.

The cross section also gives the curvature of the top in the center, and, as the wing top is straight throughout its length, the same curvature applies to the rest. All of the cut comes off the top surface, the bottom remaining flat. The "knife-edge" at the rear continues about halfway around the ends, until the gradual thickening of the wing stops it at the end of the rear full-length spar, No. 4, Fig. 14.

Complete the wing by cutting out the aileron slots, and begin applying the metal covering. This, as explained before, is made from sheets of .008-in. brass, passed through corrugating rollers and then nickeled, to resemble the duralumin of the big Ford ship. Strips of this metal, approximately 4 in. wide, can be obtained corrugated and nickeled.

is Easy to Build

The covering is applied from the wing tips toward the center, each successive strip overlapping the previous one by one or two corrugations. Care must be taken to keep the corrugations parallel to the fore-and-aft center line of the wing. Owing to the fact that the top and bottom surfaces and front and rear edges of the center 6-in. section are parallel, it is possible to cover the top, bottom and leading edge of this portion with a single sheet of metal, but the tapering portions must be covered separately up to the curved leading edge, and another strip, cut on the bias, bent around this edge, thereby keeping all the corrugations straight.



1, 2, 3, 4, AND 5, WING SPARS
A-A, AILERON CONTROLS
FIG. 14

The metal covering of the big Ford is riveted to the spars and fuselage frame, so we will use small brads with nickeled heads to resemble rivets. Fig. 14 shows the spar lines and the rivet rows should follow them, spacing the rivets about ½ in., or five corrugations, apart. Except at the aileron slots, the wing covering projects ⅛ in. past the wood at the rear edge, the top and bottom being soldered together, giving the finished wing a total width in the center section of 4 in.

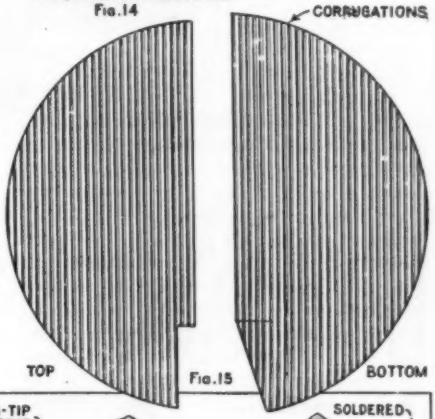


FIG. 15

As wings differ slightly in the shaping, drawings and dimensions for most of the covering strips are useless, since each strip must be cut to fit. However, Fig. 15 shows the top and bottom covering for the wing tips, full size. They are cut to project a couple of corrugations past the aileron slot, so that the next strips will overlap them, and the bottom piece has a small triangular projection to be turned up and soldered across the end of the slot.

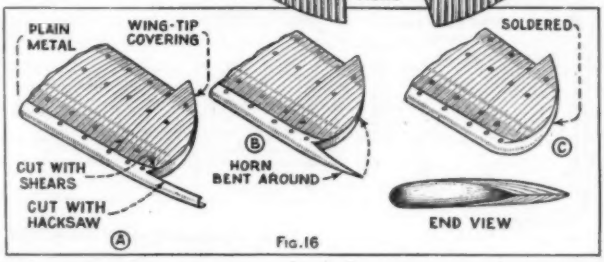
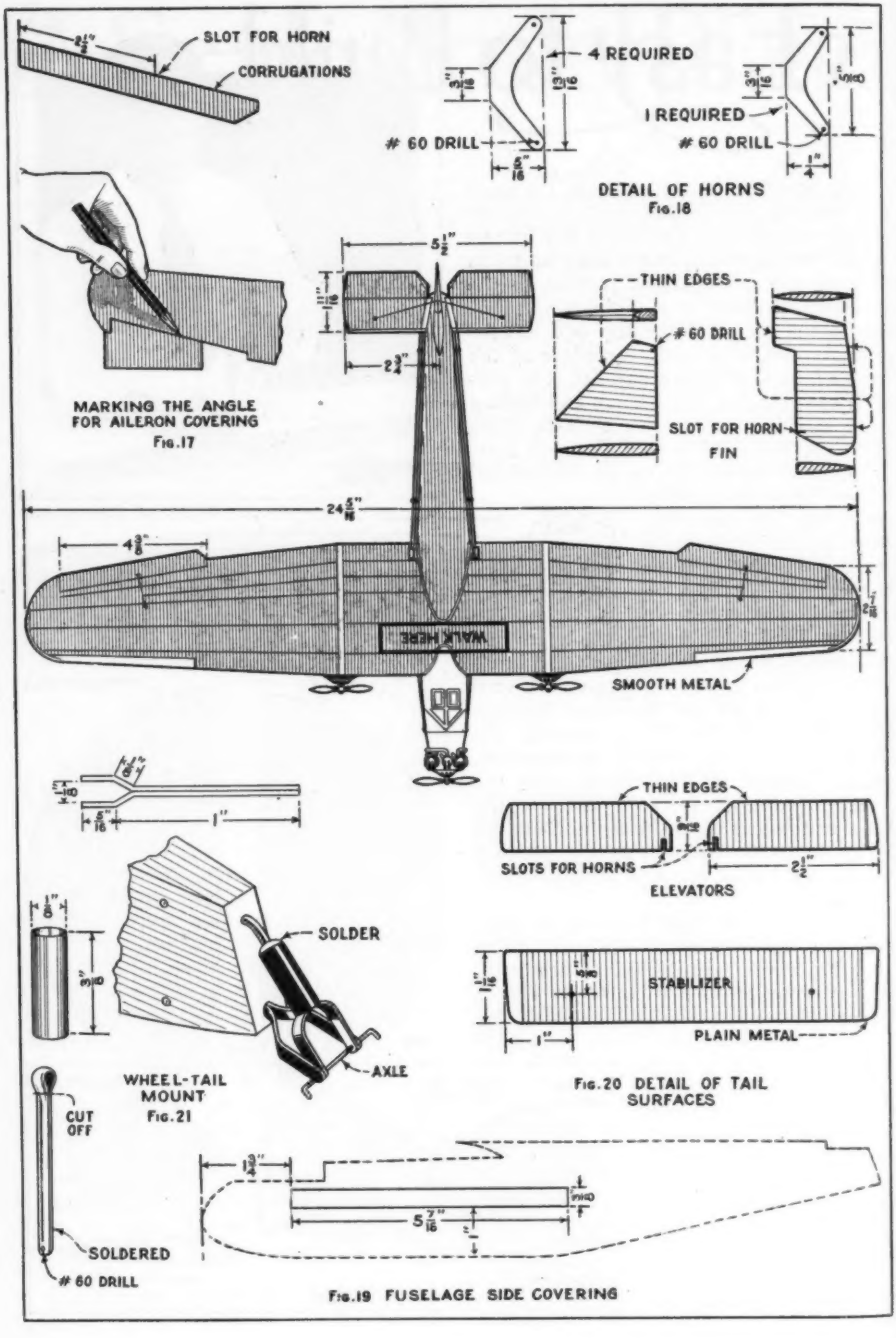


FIG. 16

Lay the top piece on the wing so that it pro-


SLOT FOR HORN
CORRUGATIONS
4 REQUIRED
60 DRILL
1 REQUIRED
60 DRILL
DETAIL OF HORNS
FIG. 18
MARKING THE ANGLE FOR AILERON COVERING
FIG. 17
THIN EDGES
60 DRILL
SLOT FOR HORN
FIN
WALK HERE
SMOOTH METAL
THIN EDGES
SLOTS FOR HORNS
ELEVATORS
SOLDER
AXLE
WHEEL-TAIL MOUNT
FIG. 21
STABILIZER
PLAIN METAL
FIG. 20 DETAIL OF TAIL SURFACES
CUT OFF
SOLDERED
60 DRILL
FIG. 19 FUSELAGE SIDE COVERING

jects about 1/16 in. past the end of the aileron slot, taking care that the corrugations are parallel to the fore-and-aft center line, and tack it in place with two brads driven through the corrugations which later will be overlapped by the next strip. Now mark the spar lines and apply a row of permanent brads. The brads can be cut to length first, or driven through and later filed down. The latter system, easier for the beginner, can only be followed on one side of the wing, however. As the other side is covered, all brads must be cut off to insure that they will not go through.

Attach the bottom piece of metal in the same way, bend up the triangular flap and solder it to the top; then solder the rear edges together, continuing around the end to the rear-spar line, where they begin to spread. This gap will be closed with plain uncorrugated metal, after the rest of the wing is completed.

Setting the "Rivets" Holding the Metal Covering; a Nailset Is Used to Prevent Damage to the Metal

Having finished the tips, lay a strip of metal on the wing, with corrugations parallel to the fore-and-aft center line, and with a ruler mark the front-spar line (No. 1) across the metal. Cut to this line, lay the metal in place with the front edge at the beginning of the curve of the leading edge of the wing, and mark the position of the aileron slot. Add slightly more than 1/8 in. to give a flange to turn down and close the slot, and cut and tack the piece in place, pulling the temporary brads from the tip, and lapping the new piece over to cover the holes. The bottom is covered in the same way, without the flange, and the two pieces soldered together where they meet. After passing the aileron slot, the covering is cut to project 1/8 in. at the rear, and these edges are soldered together to form a knife-edge.

Complete the covering up to the line 3 in. from the center of the wing, and allow your last strip to project a couple of corrugations past the line. The center section is covered with full-length strips, starting 1/8 in. behind the rear edge, continuing up the top, down over the leading edge, and back to the starting point. Because the front and back edges and top and bottom surfaces are parallel, this can be done easily and still have the corrugations come out even.

The leading edge is covered with corrugated metal from the center section to a point 4½ in. away, which brings it slightly beyond a point opposite the inner end of the aileron; from there on to the tip and around the end of the wing to the rear-spar line, a smooth covering is used. The latter is brass sheet of the same thickness, nickeled but not corrugated. After the center section is covered, make a pattern by bending a sheet of paper around the leading edge, and marking to allow it to overlap the top and bottom covering. Cut out the pattern and lay it down on a sheet of metal, with the corrugations parallel to the pattern end. Mark, cut and bend the piece around the leading edge, and, after making sure the corrugations match properly, tack it down along the top and bottom edges, the brads passing through the metal underneath.

A pattern for the plain metal to the end of the wing is made in the same way, except that there are no corrugations to watch. It is cut 4¼ in. long and, when bent and attached, projects somewhat past the end of the wing. Hold the wing on edge and with a hacksaw cut back along the center line of this projecting portion until you reach wood, as shown in Fig. 16. With the shears, cut away

the projecting portion on top and bottom, as shown in the same sketch. Take a small, narrow strip of plain metal, just wide enough to close the gap between top and bottom, bend it into place and attach with a drop of solder to the piece you have just placed. Hammering it down and trimming as you proceed, work along it, soldering each short section as it is formed, until you have completed the wing tip. This is the hardest part of the wing, but with care you can bend it, a small bit at a time, and solder as you go, until you get a satisfactory job. Clean off the surplus solder with a file, but take care not to file through the nickelplating.

Next come the ailerons. Like the wing, all the streamline curve in the ailerons is on the top surface, the bottom being flat. One end of the wooden aileron is cut on a diagonal; this is the inner end. Lay the wood in place in the wing slots, with the cut-away ends toward the center, and mark to conform to the top surface. Shape it down to a knife-edge at the rear, finishing off with sandpaper.

The aileron, set at an angle, requires a cover cut on the bias, in order to make the corrugations match those of the wing. To get this angle, lay the wing down on a strip of the corrugated metal, taking care that the corrugations of the two match, and then mark the line of the aileron slot as shown in Fig. 17. Lay the wooden aileron down, with its thick front edge matching this line, and mark the rear edge. Add 1/8 in. for the projecting rear edge, which is to be soldered to the top cover. The top is cut in the same way, except that an extra 3/16 in. is added at the front, to be turned down and soldered to the bottom. Cut both pieces slightly longer than the aileron, and after soldering the edges together trim off the ends, bend flaps over, and solder them. Be sure, before completing the ends, that the aileron is just the right length to fit snugly into the slot, and trim the rear edge down to meet the wing edge.

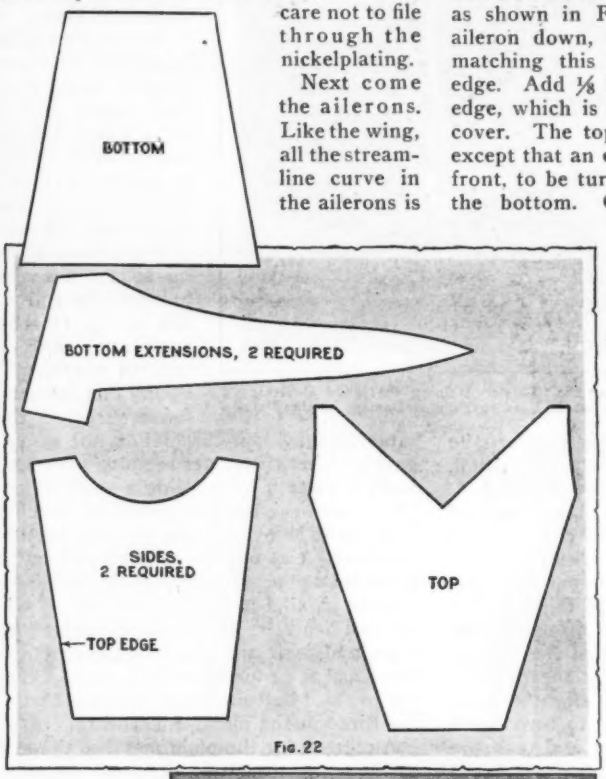


Fig. 22

Right, a Partly Covered Wing; Note the Bare Wood on the Leading Edge, Which Is to Be Covered with Plain Metal

Ailerons are operated by horns, which project above and below them, and to which the control cables are attached. These horns are cut from thin galvanized iron. Fig. 18 shows the dimensions of the horns for ailerons, elevators and rudder—four of the larger size for the first two, one of the small size for the rudder.

With a hacksaw, cut a small slot in the leading edge of the aileron, 2½ in. in from the outer end, as shown in Fig. 17, and solder the horn in this slot. Three holes are now drilled in the front

edge of the aileron with a No. 60 drill, two being ½ in. from either end and the third at the center. Corresponding holes are drilled in the edge of the wing slot. Cut the heads off three brads, drive them halfway into the wing holes, slip the aileron into place on them, and attach it with small drops of solder on the top and bottom surfaces, above and below the brads.

Notice, in cutting the horn slot, that it is at right angles to the leading edge of the aileron, and not parallel to the corrugations. Lay a 90° triangle or a try-square on the aileron edge alongside the horn and mark the line on the wing. The aileron-control cable passes into the wing ⅞ in. from the aileron slot, as shown in the plan view, Fig. 20. At this point, with a No. 60 drill, drill a hole through the wing. For control cables, fine wire is used. You can obtain a spool of No. 30 nickeled wire from the dime store. Pass one end through the hole in the upper horn and make it fast with a drop of solder, closing the hole. Then push the wire through the hole in the wing, draw it taut from below, and close the hole with a small drop of solder. Do the same to the hole in the underside of the wing, then draw the wire through the hole in the lower horn, pull taut and make fast in the same way. Clip off the end of the wire and smooth off surplus solder.

Plan View of Finished Model, Showing Location of Rivet Rows on Fuselage Top, Aileron Controls and Fin Guy Wires

Two strips of plain metal, 5/32 in. wide, cover the joint where the tapering wing sections join the center section. Cut the strips and tin one side with a thin layer of solder. Starting at the rear edge of the top surface, line the strip up along one of the corrugations and sweat it into place with a hot soldering iron. Work forward, moving the iron slowly to insure thorough heating of the metal. Continue around the front edge and down the underside of the rear edge, where the ends of the strip should come out exactly even, one above the other.

You are now ready to cover the fuselage. Start with the bottom. Lay a sheet of metal in place, with the front edge even with the nose block, and line one corrugation along a center line drawn on the bottom board. Tack it in place with two temporary nails, fore and aft, turn the fuselage over, with the metal down, and, with a scriber, mark the edges. Remove the metal, cut to shape and tack it down again, with rows of brads along the edges, spaced 1 in. apart, and two equidistant rows in between, spaced the same distance

and carried aft until the taper of the tail stops them.

The sides come next. When the Ford plane is in level flight, the top of the fuselage is horizontal, so the corrugations are laid parallel to this line, and also parallel to the top and bottom of the windows. One inch up from the bottom of a sheet of corrugated metal, and 1¾ in. from the end, lay out the window slot, ⅜ by 5 7/16 in. long, as shown in Fig. 19. The easiest way to cut out the window aperture is with a good stout jackknife, or a sloyd knife, as the thin sheet brass can be cut with a firm, steady pressure, without bending the sheet out of shape. Line the sheet up, with the slot just matching the window opening, and secure it in place with a couple of temporary brads. A good place for these is in the corrugation valley on which the top window line is cut, and ½ in. in front of and behind the ends of the windows.

Turn the fuselage, metal sheet down, and scribe the bottom edge, rear end, bottom edge of the stabilizer slot, and the wing slot at the top, as shown in Fig. 19. Pull out the brads and remove the metal, cut the bottom edge and rear end, and cut the top on a corrugation line two rows above the bottom of the stabilizer slot. The top cover, when it is applied, will reach down just to the bottom of the slot, and thus cover those two projecting rows of corrugations, to permit nailing. Next cut the wing slot, lay the metal in place again, and mark the bottom edge of the side windows in the cowling of the pilot's cockpit. The side covering is cut away to this window line, continuing back almost to the end of the galvanized-iron cowling, leaving just enough overlap to solder the two together.

Nail the side in place with rivet rows as shown in the side view of the model, two long rows at the top, one row along the bottom edge, and vertical rows 1½ in. apart from the windows to the tail. The method of marking the bottom edge insures that it will overlap the bottom slightly. With a hammer tap this edge down. It should fit so well that no soldering will be necessary.

The other side is cut and fitted in the same way, except that it may be made 3/16 in. longer at the tail, bent over and soldered to the first piece, or a small strip of metal can be soldered in place.

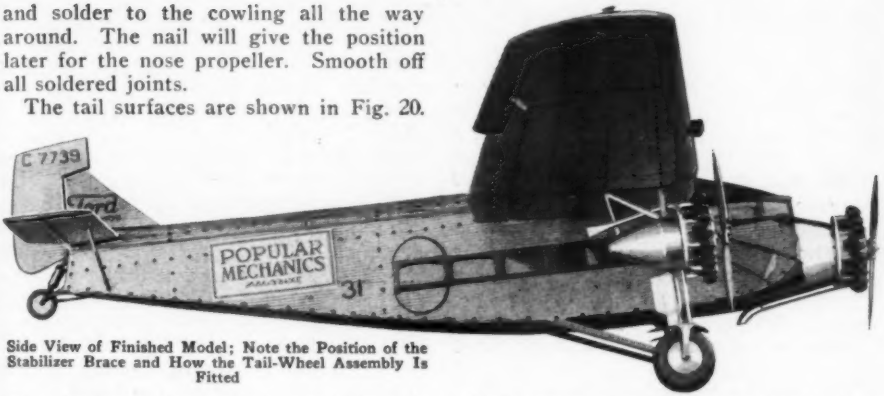
The top is fitted very much like the bottom. Mark the center line on the wood and tack a strip of metal in place with two temporary brads, lining a corrugation on the center mark. Bend the strip down to the side and mark it at the bottom edge of the stabilizer slot. Trace the same corrugation of the side to the forward end, and mark the position on the top piece. After both sides are cut (owing to the taper of the tail they should be cut on the bias), bend them down again, and, holding them in place, turn the fuselage over and mark the rounded front of the roof, which later will project over the top of the wing. Cut this slightly full, to insure plenty of metal to solder the joint to the wing.

Full-size templates for the nose cowling are shown in Fig. 22. The cowling, of plain nickeled metal, continues back in graceful lines along the bottom corners of the fuselage to a point below the rear side of the first cabin window. These extensions are cut from separate pieces of metal, as shown. The small square projections on the front ends of the strips go part way across the bottom of the nose, on the same line as the cowling. Draw a line across the bottom 1½ in. from the nose, hold the strip of metal in place, with the rear edge of the projection on the line, coat the under surface of the strip with solder and tack it down with a temporary brad. Tap the other edge down to the side with a hammer and put in a second brad. With the hammer, bend one side down into contact with the fuselage and sweat it into place with the hot iron. Do the same with the other side; then the temporary brads can be pulled.

The cowling itself is put on like shingles, lapped to shed water, so the bottom comes first, fitting it to the line 1½ in. from the nose. Tack it down with three brads across the rear end, and bend the edges around the nose. Apply the sides next, in the same way, overlapping the bottom, and nail the two together. The top is then fitted, nailed and soldered to the cockpit-window cowling. Cut a ¾-in. disk of plain metal, drive a brad through the center and into the center of the nose,

and solder to the cowling all the way around. The nail will give the position later for the nose propeller. Smooth off all soldered joints.

The tail surfaces are shown in Fig. 20.



Side View of Finished Model; Note the Position of the Stabilizer Brace and How the Tail-Wheel Assembly Is Fitted

The leading edge of the stabilizer is thinned down and rounded, while the rear edge remains full thickness. As the front edge is slightly round, like the leading edge of the wing, and the front and rear edges are parallel, a single piece of metal will cover the entire stabilizer. Lay the wood, after it has been shaped by rounding down the top surface, on a sheet of the corrugated metal, rear edge about 1/32 in. from the end of the metal, and bend the strip up and over the front edge of the wood. With a hammer, bend it down the thick rear edge, clip off and solder. The ends of the stabilizer, as shown, are formed of smooth metal, in much the same manner as the wing tips.

The elevators, like the wing and stabilizer, are flat on the bottom and curved on top, coming to a knife-edge at the rear. Like the ailerons, they are cut away at the inner end, and care must be taken to see that the shaping is done on the top surface of both elevators. Corrugations run fore and aft, as shown, and the tips can be either of plain metal, or may be bent over and formed from the main sheet, flattening the corrugations out with a light hammer.

The elevators are attached to the stabilizer, with their outer ends matching, using three nails, in the same manner as the ailerons, and finishing off with spots of solder. The slots for the elevator horns are cut 1/8 in. in from the inner end, as shown.

The vertical fin has a thick rear edge, and a knife-thin leading edge, as shown in the sketch, Fig. 20. It is shaped on both sides, instead of one, differing therein from elevators and ailerons. The corrugations are parallel to the bottom edge.

The rudder has a thick edge where it joins the vertical fin, but the small part projecting over the fin is thin on both edges, the rear being a knife-edge; the shaping in each case is done on both sides, as the end views show. The corrugations are at right angles to the thick edge, which joins the fin, and match it when the two are assembled. The horn slot is cut 1/8 in. up from the bottom, in the thick edge. Drill a No. 60 hole through the fin in the upper rear corner, as shown.

Mark the center of the stabilizer, slip it into the slot, and line it up at right angles to the rivet line down the center top of the fuselage. Nail it in place with two long brads passing through the top, stabilizer and tail block. Solder the top covering to the stabilizer, where the two are in contact, at the rear, but leave the wider slot at the front edge open, as the stabilizer, on the real ship, moves up and down in this space to compensate for shifting loads.

Drill three No. 60 holes in the bottom and rear edges of the vertical fin, and corresponding holes in the fuselage and the rudder. Fit headless brads in the fuselage holes, slip the fin onto them, and solder it to the fuselage.

The fin is braced by guy wires to the stabilizer, the wire passing through the small hole drilled in the upper rear corner of the fin. Drill holes through the stabilizer 1 in. from the ends and 5/8 in. from the rear edge, as shown in the plan,

the rear edge, as shown in the plan, in Fig. 20. Pass the end of the wire through one hole and solder it on the bottom side. The stabilizer is reinforced on top with small squares of plain metal. Cut a strip of plain nickeled brass 5/32 in. wide, drill a No. 60 hole through it, and cut off a square with the hole in the center. Coat one side with solder, slip it onto the wire, and sweat it to the wing. Draw the wire taut through the hole in the fin, solder it on both sides, and slip another reinforcing square over the end, then pull the end taut through the hole in the stabilizer, solder it from below, and sweat the reinforcing square into place.

The stabilizer is braced from beneath in the same way, except that streamlined struts are used instead of wire. The struts are made of plain nickeled metal, have a rounded front edge and a sharp trailing edge, and are 5/32 in. wide. Cut two strips of uncorrugated metal, 3/8 in. wide and 1 7/8 in. long. Mark the center line and bend slightly, then finish the bending around a 1/16-in. wire, or a nail, giving a smoothly rounded leading edge. Solder the rear edges together, and with the shears clip the ends on a bevel until they fit snugly against the underside of the stabilizer, and against the fuselage at its bottom edge. The outer end is soldered over the lower end of the top bracing wire, and the inner end to the fuselage at a point exactly opposite, so the strut is parallel to the plane of the leading edge of the stabilizer.

Before the rudder can be attached, completing the tail surfaces, it is necessary to install the tail-wheel mounting. This is made from two cotter pins, 1/16 in. diameter and 1½ in. long. The details are shown in Fig. 21. Flatten the ends slightly and drill a No. 60 hole through both parts of the pins. Bend and form the forks, then solder the shanks together, and clip off the heads of the pins. The upper member carries a shock absorber, the model of which is made from a strip of the plain metal, 3/8 in. wide. Bend this to form a tube of 1/8-in. diameter, solder the edges together, slip over the pin, and fill both ends with solder. With a small file, smooth the solder down to a slight taper at the end. The two parts are assembled with a temporary wire axle thrust through the holes, so that they will be kept in alinement while the parts are being soldered to the fuselage.

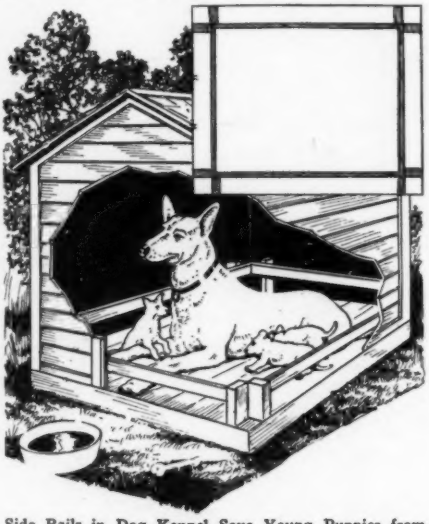
Drill a 1/16-in. hole in the tail of the fuselage, 1/16 in. up from the bottom, and a similar hole ½ in. above it. Bend the shanks of the pins, insert them in the holes and solder in place.

Attach the rudder, with brads and drops of solder, to the fin, and the tail assembly, except for control wires, is complete.

(To Be Continued Next Month)

Side Rails in Kennel Save Puppies

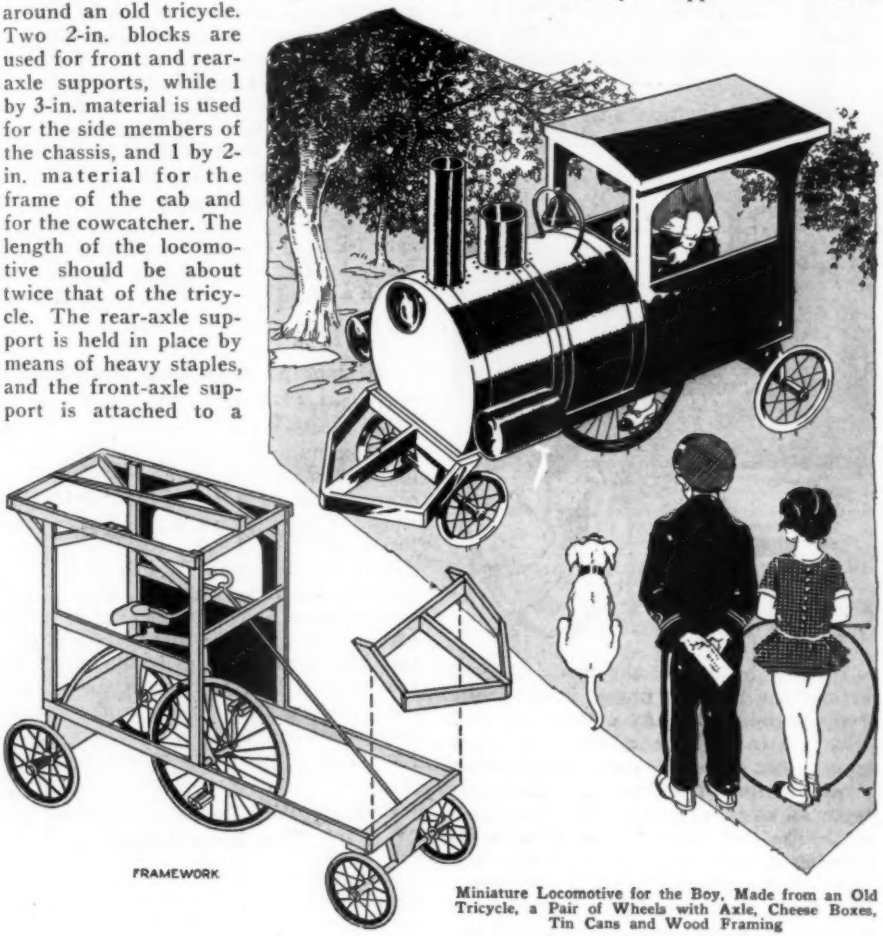
Sometimes puppies are accidentally killed in their early life by the mother crushing them against the kennel walls. This can be prevented by providing side rails. Nail blocks of 2 by 4-in. stock, 8 in. high, in each corner as indicated, to serve as supporting blocks for the rails, which must be smooth. The lower edge of the rails should be at least 5 in. above the floor, although greater clearance may be necessary for the larger breeds of dogs. When the mother lies down against the side rails, the puppies will be pushed underneath the rail, saving them from being crushed.—M. W. Meier, Kalamazoo, Mich.



Side Rails in Dog Kennel Save Young Puppies from Being Crushed

Miniature Locomotive for the Boy

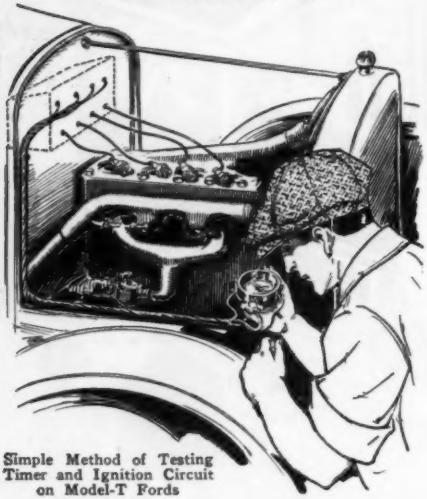
Any father can gladden the heart of his son by constructing the miniature locomotive shown in the drawing. It is built around an old tricycle. Two 2-in. blocks are used for front and rear-axle supports, while 1 by 3-in. material is used for the side members of the chassis, and 1 by 2-in. material for the frame of the cab and for the cowcatcher. The length of the locomotive should be about twice that of the tricycle. The rear-axle support is held in place by means of heavy staples, and the front-axle support is attached to a piece of 1-in. stock, which is nailed across and under the side members. Get a front axle from a discarded coaster or similar cart, and pivot this on the front support. To steer the locomotive it is, of course, necessary to turn the front wheels in conjunction with the front wheel of the tricycle, which can be done by connecting the two by means of a ¼ or ⅜-in. iron rod, the ends of which are formed to eyes to fit over the tricycle handlebar and the front axle. The correct position for the rod on the front axle is halfway between the pivot and the wheel. To prevent its slipping out of this position, a length of wire is securely wrapped and twisted around the axle on either side of the bar. The same precaution also applies to the attachment of the rod to the handlebar. The boiler consists of two cheese boxes set end to end on the chassis, nails being driven through the side members to hold the boxes in position. Empty 2-gal. sirup pails are tacked to the sides as indicated, to represent cylinders, while the smoke-stack and sandbox are made from suitable tin cans. If a small bell is available,



Miniature Locomotive for the Boy, Made from an Old Tricycle, a Pair of Wheels with Axle, Cheese Boxes, Tin Cans and Wood Framing

it is suspended on a strap-iron bracket and a string is attached and brought into the cab for the convenience of the engineer. An old auto headlight can be mounted on the front to serve as a searchlight. Canvas is used to cover the cab and a coat of black paint is then applied, to complete it.—Lawrence E. Reed, Stanton, Nebr.

Timer and Ignition Test on Fords and Fordson Tractors



Simple Method of Testing Timer and Ignition Circuit on Model-T Fords

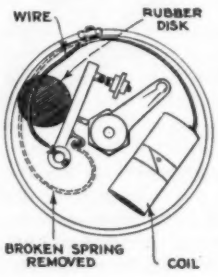
Ignition trouble in the model-T Ford car and the Fordson tractor is frequently encountered, and many owners are at a loss how to find the cause. The timer may be out of order, the wiring harness short-circuited or broken, the coils incorrectly adjusted, or one coil may be defective. The test method illustrated in the drawing is one that any car owner can apply, as it requires no special equipment. The timer is removed by springing the retainer aside and taking it out with the four terminal wires attached. With the switch placed on the battery side of the circuit, each of these terminals is in turn touched against the engine casting. The contact causes the coil in this circuit to vibrate, and a spark will occur at the plug. Absence of a buzz of the vibrator indicates that the trouble is in the wire, coil or coil points under test. The spark plug can be removed and placed on the cylinder head. As soon as the trouble is definitely located in one of the circuits, the wire is tested separately. A length of wire from the dash terminal to the timer terminal can be shunted around the old wire. If this extra wire causes the coil to buzz and the plug to spark, it will be evident that the old wire is broken. If, when testing, all terminals produce a solid buzz, and the plug is known to be in good condition, the trouble will possibly be in the roller which revolves inside of the timer. Bend this outward with the end of a screwdriver, replace the timer, and it is probable that the engine will fire on all cylinders. With the four plugs on the cylinder head and the timer removed, the method described makes it possible to tell in a very short time how each ignition circuit is working.

Hectograph Made from Old Films

Discarded photographic films can be used to make a hectograph capable of duplicating up to 50 copies of anything written, drawn or typewritten, provided hectograph ink or a hectograph typewriter ribbon is used. Just soak the film in a solution of water, 1 part, glycerine, 1 part, and a little sugar. When the shiny side has been thoroughly soaked and is soft, remove and blot off surplus moisture. Then place the soft surface in contact with the original to be duplicated for a minute. Remove the copy sheet and substitute successive sheets of plain paper. Rub and press them down firmly, preferably with a small roller.

Emergency Repair on Broken Distributor Spring

A spring in the distributor of my car, which ordinarily keeps the contact points together, was broken and a new one was not immediately available, so I made the emergency repair shown in the drawing. I took a rubber disk from a hydrometer and inserted it between the distributor case and the



contact-point arm, so that it would act as a spring to push the contact points together. Then I ran a small wire to renew the electrical connection formerly made by the broken spring. The car started without any trouble, and I was able to proceed to the nearest garage where the spring was replaced.—E. A. Larmer, Hasbrouck Heights, N. J.

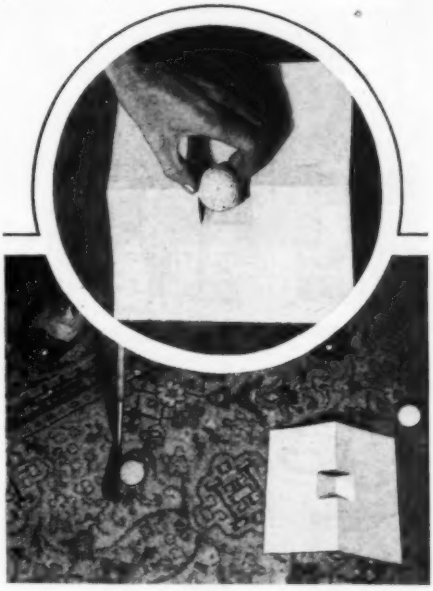
Hole Eliminates Air Pocket in Grease Gun

Every user of a grease gun knows the trouble usually experienced in filling it, owing to the air pocket which forms in the cylinder before it is full. To eliminate the trouble, I merely drilled a 1/16-in. hole in the wall of the gun, near the end where it connects to the fittings, and threaded the hole for a short screw. Every time I fill the gun the screw is first removed, which lets the air inside escape as the grease is pressed into the cylinder. —John Edwin Hogg, Alhambra, Calif.

Handy Cork Extractor

A simple tool for removing a cork from the inside of a bottle may be made from a common safety pin. Cut off the head, sharpen the cut end and bend both points at right angles, as shown in the photo. Make a handle from a length of No. 8 gauge wire, flattening one end for about 1 in. Bend this end through the eye of the pin and pinch the eye so that it will hold the pin securely. In use, press the prongs together and insert the tool into the bottle. It is easy to catch the cork with the sharp points and pull it out.—Frank W. Bentley, Jr., Missouri Valley, Iowa.

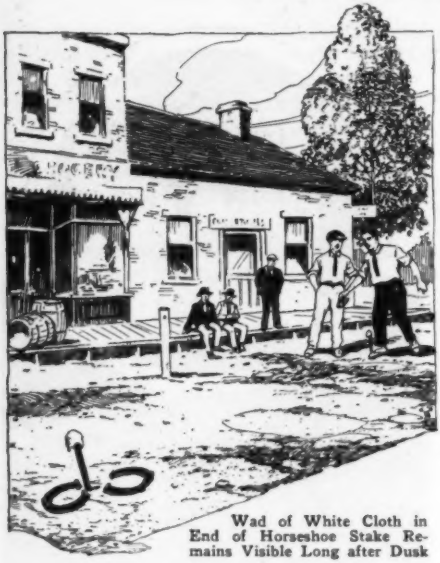
Salt sprinkled on the window sill under the sash prevents it from freezing.



Cardboard Putting Green Provides Practice and Diversion for the Golf Enthusiast

Cardboard Putting Green for Indoors

If you are an enthusiastic golfer who simply must practice during the winter months, or if you are merely seeking a new form of indoor recreation, the putting green shown in the photo will interest you. Get a sheet of cardboard, about 10 in. square, and fold it once through the middle. Cardboard from a suit box is good for the purpose. Cut a slit, 1½ in. long and at right angles to the fold, about 1 in. on each side of the center. Open the cardboard until it is nearly flat and push the center section in until it is folded in the opposite direction, forming a pocket. Besides this you will need a putter, one or more golf balls, or small wood or rubber balls of the same size, and a level surface, preferably a rug or carpet. Your shot must be accurate and not too energetic. The fact that the hole is approachable from only two directions makes the task more interesting. A nine-hole golf course can be constructed indoors in a few minutes, and will provide excellent entertainment for a party.—Walter E. Burton, Akron, Ohio.



Wad of White Cloth in End of Horseshoe Stake Remains Visible Long after Dusk

Flag for Horseshoe Stakes

When playing horseshoe in the evening, the stakes often cannot be seen clearly. Painting them white is only a temporary solution as the paint is soon knocked off. A better method is to roll up a piece of white cloth to form a wad, one end of which is pushed into the hollow upper end of the stake (usually a length of pipe). Let about 3 in. of the cloth project above the stake and you will find that it can be seen long after the stake itself becomes invisible.—James F. Goodman, Stockbridge, Mich.

Storing Blankets on Top of the Car

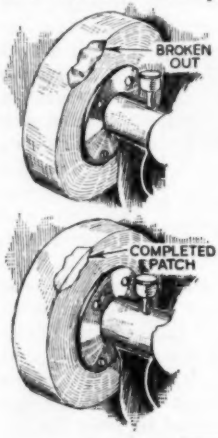
Blankets and mattresses are bulky to carry in the car when out on a camping trip. One of the best methods of carrying them is to strap them on the top. Of course, it is advisable to cover them with a large piece of tarpaulin to protect them from the weather, and it is a good idea to lay the canvas on the top of the car first, then pack the blankets, mattresses, overcoats, etc., after which the rest of the canvas is folded over the pile. Obviously, the piece of canvas must be twice the size of the car top. It is necessary to tie the pile down securely at all corners and especially at the front end so that the air pressure created by the speed of the car will not loosen it.—Harold E. Benson, Denver, Colo.

Honing Carving Tools

Woodcarvers, especially those working on small, intricate work, have a simple method of keeping the edges of their chisels smooth and keen. They use a piece of fairly thick leather, to which a mixture of oil and fine emery or carborundum powder is applied. Stroking the edge of the tools frequently over this abrasive surface keeps them so sharp that a stone is usually not needed. An occasional drop of oil is required on the strop, but no more abrasive powder.—J. S. Hagans, Chicago.

Simple Repair for Grindstone

A grindstone shipped to me had a large portion of the edge broken off; so I repaired it with a mixture of cement and sharp sand. I sawed a couple of short boards to the same curvature as the stone and clamped one of them on each side of it. I then filled in the broken spot with a mixture of cement and sand and struck it off with a small piece of wood, spanning the boards on the sides of the stone. In doing this, care must, of course, be taken to get the patching cement of about the same hardness as the stone itself, which is done by adding a sufficient quantity of sand. The repaired stone has been in constant use for six years. —August Jeffers, Bedford, Ind.



Cleaning Rubber Articles

To clean rubber articles, dip a cloth in melted paraffin and then in some kitchen cleaning powder. Rub the articles with this and then wash off with water.

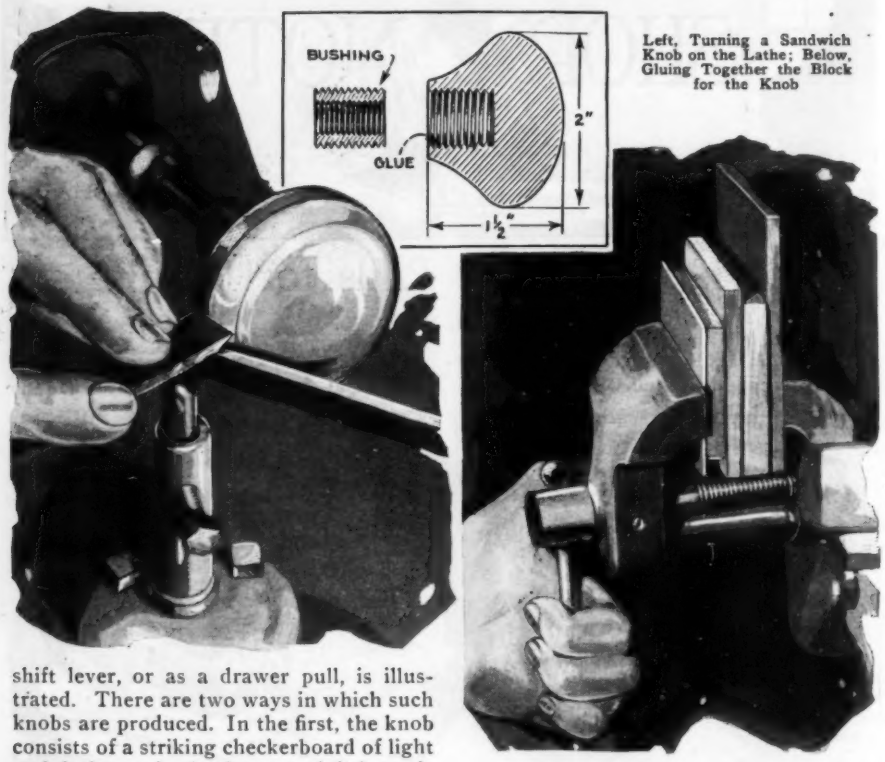
Individual Drawer Pulls for Furniture

By W. E. BURTON

THE MODERN tendency in furniture is to secure the utmost in effect from the beauty of the wood itself, rather than from the finish. The craze for unusual effects in crackled and other lacquer finishes is passing, and more and more cabinetwork depends for its appeal on the unadorned grain of beautiful wood. The amateur mechanic, in following this tendency, will be interested in knowing how striking and individual knobs for furniture can be made. The process is an old one, but not as well known as it should be, and it is not restricted to drawer pulls. Fancy gear-shift-lever knobs for automobiles, chisel handles, lamp stands, candlesticks, and many other articles, are turned out by this method.

Above, How the Wood Is Assembled for Checkerboard and Sandwich Knobs; Below, a Finished Checker Knob

As an example, a knob suitable for use on an auto gear-



Left, Turning a Sandwich Knob on the Lathe; Below, Gluing Together the Block for the Knob

shift lever, or as a drawer pull, is illustrated. There are two ways in which such knobs are produced. In the first, the knob consists of a striking checkerboard of light and dark woods; in the second, it is made up of layers of different woods of contrasting colors.

For the checkerboard effect, the material is prepared (say, that maple and walnut are used) to make a collection of smoothly finished strips, about ¼ in. square and 5 or 6 in. long. These are glued together so that, in cross section, a checkerboard design is obtained. The bundle is about 2½ in. square for an automobile knob. A good quality of glue is used, and the bundle clamped together under enough pressure to eliminate hollow spaces. When the glue has set, the bundle is sawed into 2-in. lengths to obtain blanks for the knobs.

If the sandwich design is chosen, this is formed by gluing together several layers of different woods and then turning the knob so that it appears to have inlaid rings around the edge. The simple design shown in one of the illustrations was made by gluing a ¼-in. maple piece between a walnut and a cedar block, and turning with the walnut on the outside. After the blank is formed, turning is done on the lathe, or on a motor or polishing head equipped with a chuck. If the latter is used, a wood screw, with the head cut off, is driven into the blank for a short distance, and the other end is clamped in the chuck like a drill bit. Sharp tools are to be used when turning, and the knob is finished off with fine sandpaper. The shape and size of the knobs are varied to suit individual taste, although a good size is shown in the dimensioned drawing.

When turning is completed, the next step is to apply the finish. Shellac may be used for this so as to produce a kind of French polish. While the knob is still in the lathe, a coat of white shellac is applied, and the lathe is started. By holding a lintless cloth against the surface, the shellac is spread out in a thin, highly polished layer, which will dry in a few minutes of whirling. If the shellac piles up

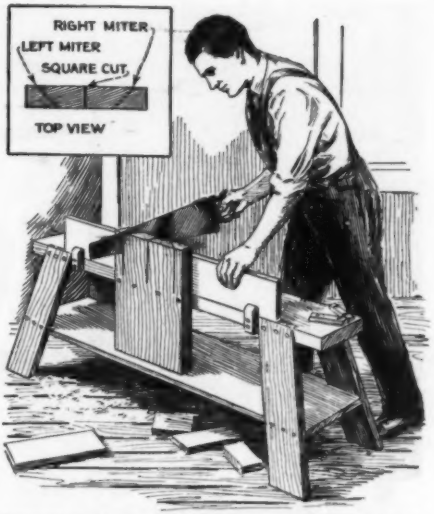
in places, the high spots are removed with oiled No. 00 sandpaper and the polishing repeated, or a rag moistened in alcohol may be used to iron out uneven places.

Several coats may be applied in this manner, the result being a highly polished surface not obtainable in the ordinary way. The wood may also be filled, if necessary, and a coat of varnish, clear lacquer or even wax applied. The lacquer is applied in the same way as the shellac.

Finally, the knob is fitted with a bushing, if it is intended to be used on a gear lever. Bushings of the correct size are obtainable from most auto-supply dealers, and consist of short pieces of brass tubing, threaded inside and out. A hole is drilled in the knob (using a drill, not an auger bit) so that the bushing fits snugly. The outside of the bushing is then coated with glue or some cement and it is then pressed into the hole. The binding material is allowed to set thoroughly before the knob is used.

There is just one precaution to observe about wood knobs. If the finish starts to wear off, it should be renewed at once, otherwise the wood may become permanently stained with grease or dirt, rendering the knob unsightly.

The building up of the stock for candlesticks, lamp stands, etc., is done in exactly the same manner, except, of course, that the size of the pieces depends on the purpose for which the blanks are to be used. Many beautiful effects may be secured in this way. When it is necessary to stain one of the woods, leaving the other "natural," this is done by carefully painting with white shellac over the parts that are to be natural. When dry, the piece is stained. The shellac keeps the stain from penetrating the coated parts. When the stain has dried, the whole piece is finished in any of the ways described.



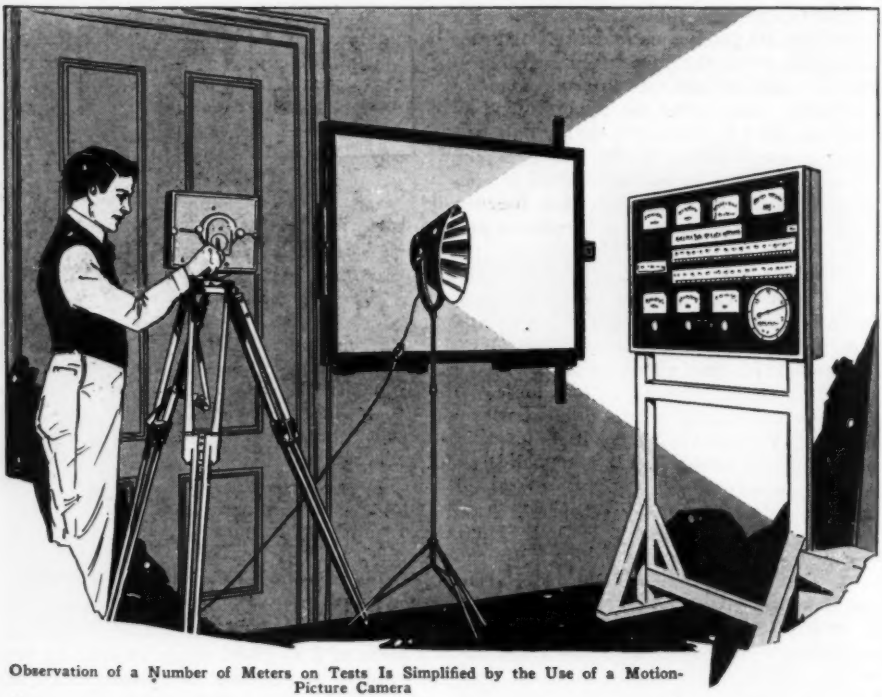
Improvised Miter Box Made by Nailing Two-Inch Stock to Top of Sawhorse

Improvised Miter Box on Sawhorse

A carpenters' sawhorse can be equipped with an improvised miter box by nailing a piece of 2 by 10-in. stock, resting on the tool shelf, to the top, care being taken to get it at exactly right angles to the top. Then the miter cuts are made. This type of box has many advantages over the old three-sided box. Being higher than the latter, it provides a better guide for the saw and enables one to miter a baseboard or other wide stock that will not fit the other kind. Besides, there is very little danger of its becoming crooked or warped, and it will not break so easily as the box type.—W. Kateley, Cleveland, Ohio.

Saves Battery Oxides

A western battery-shop owner saves about $20 every month by trapping the leads and oxides that leak from storage batteries as they are being washed. He has an old bathtub in one corner of the shop where the work is done. Leads and oxides settle to the bottom of the tub and are drawn through a pipe, inserted at the bottom, to a near-by trap, which retains the sediment. This is removed periodically and utilized for the repairing of other batteries, or sold.—Ruel McDaniel, San Antonio, Tex.



Observation of a Number of Meters on Tests Is Simplified by the Use of a Motion-Picture Camera

Camera Aids in Power Tests

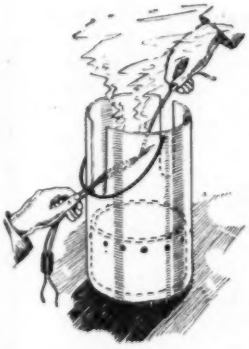
A full load-time test on a large turbo-generator ordinarily requires a number of quick-reading observers stationed at the instrument boards, to read electrical power, speed, temperature values, etc. The same may be said of tests on hydroelectric-power equipment, converter plants, and the like. When the test is of long duration, the problem of getting a sufficient number of accurate observers becomes acute. A South African engineer, Mr. L. B. Woodworth, has evolved a method whereby the problem becomes a relatively simple one, a single observer being able to obtain the same, or even more accurate, results than many men. He simply sets up a motion-picture camera before the instrument board from which the readings are to be taken and photographs the readings. The meter frame for portable testing instruments is a plain rectangular wooden framing, 6 to 8 in. deep, with two or three shelves and mounted on wooden legs so that its center is about the height of the camera lens. The frame is painted dull black, and the shelves are arranged so that all the meters mounted on them come to the same vertical plane. An essential instrument is a timer or second clock, which, when photographed along with the meter readings, gives the time value for any particular reading. Special devices, of course, such as tachometers, pointers to show lever movements, etc., may be fitted to the frame, or to the instrument board under observation, for any particular test, and driven by flexible shafts. Adequate lighting is also a necessity, mercury-vapor lamps serving quite well. The board should be illuminated from two directions, to prevent shadows on the scales of the meters. Also, the meters used should preferably have a large indicating point, and thick, easily readable division lines on the scales. If the test requires only up to ten photographic readings at, say, not less than seven-second intervals, an ordinary small camera with a ten-exposure roll film may be employed, a crank movement being substi-

tuted for the ordinary film-winding nut. The negative may be read direct or printed in the usual way. If the test requires a number of readings, taken at the rate of twenty per second or at higher values, then a movie camera is necessary. The ordinary small tourist movie camera is quite successful, using 16 or 35-millimeter film. The positive film may be projected on a screen in the usual manner or, for plotting the results, the "frames" may be thrown on the screen one at a time while the readings are plotted. The clock in the picture gives an exact time value for each reading. Projection of a 16-millimeter film on an 18 by 20-in. opal-glass screen at a distance of 8 ft. has given good results. On a long test, the camera can be driven by a small motor.

Pipe Caps Make Threaded Arbors Safe

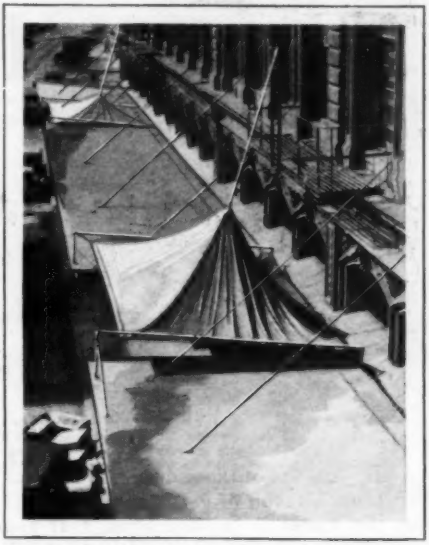
In almost every small shop, garage, and even in the home workshop, there is an emery wheel of some sort, but on most of them the threaded end of the shaft projecting beyond the nut is left without cover, which is unsafe. On my own grinder I provided protection by brazing an iron pipe cap to the nut. A 1/8-in. vent hole is drilled through the cap to allow the air to escape. Be sure that the cap is arranged perfectly concentric with the nut before brazing.—Emil B. Lee, Charles City, Iowa.

Improvised Soldering Lamp



For those who do small soldering jobs occasionally, the soldering lamp shown in the drawing is easily improvised. It consists of a can of solidified alcohol placed in an empty tin can. The top of the larger can is cut off and two slots are cut in the sides to allow the insertion of the work.

"Insert" Awnings Aid Trucking

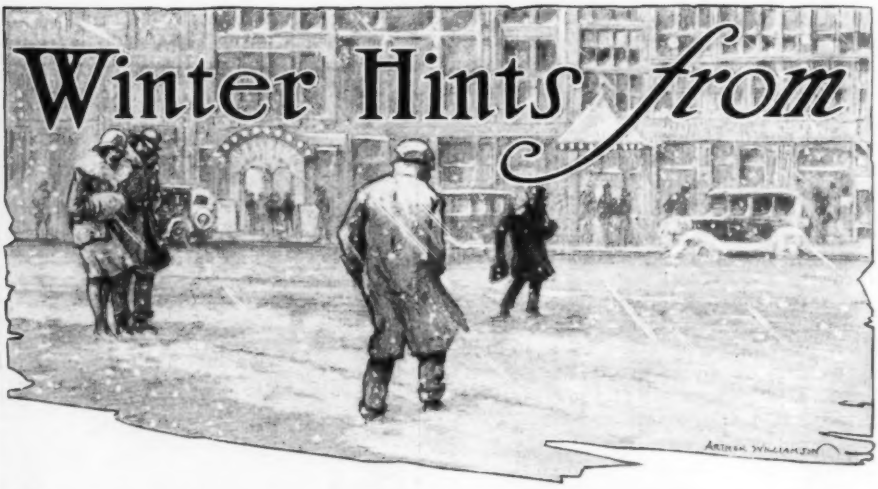


These Canvas-Covered Openings in a Permanent Canopy Permit Large Trucks to Be Backed to the Curb

Permanent awnings in front of warehouses, to protect goods on the sidewalk against the weather, have the disadvantage that they do not allow a truck with a high body to back against the sidewalk, unless, of course, the awning does not project so far. To eliminate this disadvantage, the solid awning on a warehouse in Portland, Oreg., is arranged as shown in the photo. At intervals along the length of the awning openings are left into which a large truck can be backed. Over these openings canvas covers are arranged. When a truck backs in, the cover is hauled up by means of the rope attached to its center, the height to which it is raised being limited by the pipe rails seen on the sides of the opening. When the truck is loaded and goes out, the cover is lowered as may be seen in the background, so that the goods underneath are again completely protected.

¶Emergency veining tools that will give satisfactory service may be made from old umbrella ribs or steel writing pens, sharpened or flattened to suit the work in hand; the parts are cut to the required length and inserted in a wooden handle.

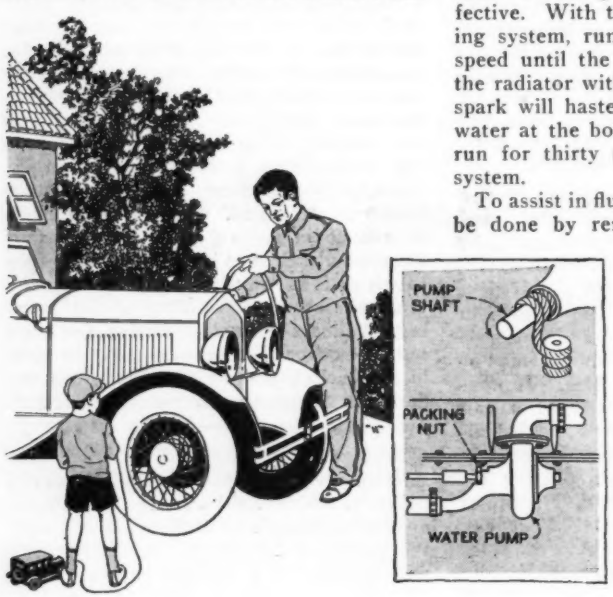
Winter Hints from



ARE you one of those drivers who think that this stuff of getting the car ready for the winter is "all the bunk"? If you are, take the advice of an old hand at the game, and get rid of this notion as quick as you can. It's costing you money. Many of our spring and summer repair bills can be traced to some little thing that we neglected to prepare for in the winter, and, even aside from the winter's toll in repair bills, comfort and freedom from care in winter driving depend entirely on the thought given the car at the start of the season. And the job takes only an hour or two, so give your car a chance.

First clean out the cooling system by using any flushing compound sold by automobile-supply stores. If this is not available, a pound of ordinary washing soda to each gallon of water will be effective. With the compound in the cooling system, run the engine at moderate speed until the radiator boils. Covering the radiator with paper and retarding the spark will hasten the heating. With the water at the boiling point, let the engine run for thirty minutes. Then drain the system.

To assist in flushing, the draining should be done by removing the bottom hose and placing a garden hose in the neck of the radiator, then letting the water run until it comes out clear. Now place the hose in the top connection of the cylinder block and flush out the water jackets until the water flows clean. As a clogged tube in a radiator will freeze more quickly than one in which circulation is free, this cleaning out is very important.



A Racing Driver

By Joe Dawson

Joe Dawson with his winning smile, as he appeared shortly after driving to victory in the 1912 Indianapolis 500-mile race. Working all of his life on automobile design and service, his advice is well worth following.

Anti-freeze costs money, and any leaks should be taken care of before putting the solution in the system. Remove each piece of radiator hose. If it is hard, cracked or peeling on the inside, it should be thrown away and new hose put on. When installing hose, coat the inside of each end with white or red lead. This will make it slip onto the connection easily and will help keep the joint tight. When putting the clamps on, a drop of oil on each screw will make them easy to tighten. If the clamps have been bent out of round they should be made circular before being put back. Failure to do this results in uneven pressure, and leaks are likely to develop.

The boiling out of the radiator usually cleans the lubricant out of the water pump, so the bearings should be greased at once. Also the packing may have been softened. If the packing nut goes all the way down without causing the pump shaft to tighten up appreciably, new packing should be put in the pump, wrapping the packing as in one of the sketches.

All cylinder-head nuts should be pulled down tight, as anti-freeze sometimes works out between the head and the cylinder block. Other places to tighten include nuts that hold the water pump to the engine and the cap-screws that hold cylinder-block water-jacket covers in place.

The Welsh plugs (shown on this page) that look like telephone slugs and which are seen in the sides of some cylinder blocks, frequently leak, especially after the car is a year or two old. These leaks can be stopped by soldering the plugs to the block. That however, is rather hard to do. The easiest way is to drill a ⅛-in. hole in any plug that leaks and pull the plug out with a button hook. Then scrape all rust from the plug and from the block where it fits. Solder up the hole that was drilled in the plug. Coat the plug and block with red

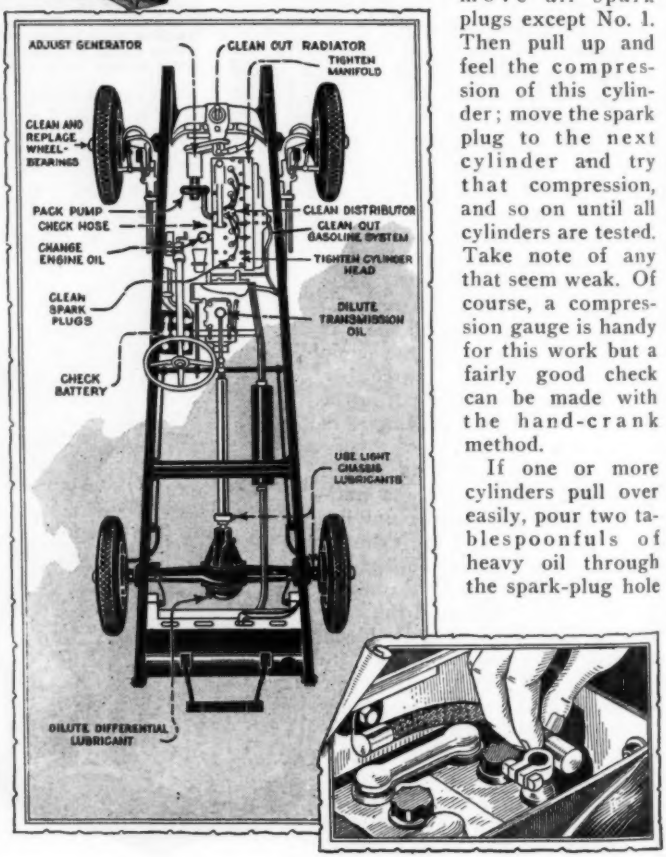
lead and tap the plug into place. These plugs are made curved and should bulge out when installed. Tapping them in the center with a light hammer will expand them slightly and frequently stop leaks without the trouble of removing. The bulge of the plug is slightly exaggerated in the drawing.

Some anti-freeze solutions, particularly those containing glycerine, are said to "eat" holes in radiators. What actually happens is that the radiator already has bad spots in it, but is not leaking, because of foreign matter clogging these places. The anti-freeze solutions referred to have a powerful cleaning or flushing action which removes the foreign matter. Then the radiator leaks. After putting in any anti-freeze for the winter, it is well to watch the radiator to see that it is not leaking. If leaks do develop, it is best to remove the radiator and have all leaks soldered, as many anti-freeze solutions dissolve some radiator sealing compounds.

Next to protection from freezing, easy starting is most important for enjoying your car in winter. The first thing to do is tune the engine.

This cannot be done unless the compression is even in all cylinders. This should be tested with the hand crank. If the engine has four cylinders, merely pull up half a turn at a time until four compressions have been felt. If the engine has six or eight cylinders, it is well to remove all spark plugs except No. 1. Then pull up and feel the compression of this cylinder; move the spark plug to the next cylinder and try that compression, and so on until all cylinders are tested. Take note of any that seem weak. Of course, a compression gauge is handy for this work but a fairly good check can be made with the hand-crank method.

If one or more cylinders pull over easily, pour two tablespoonfuls of heavy oil through the spark-plug hole

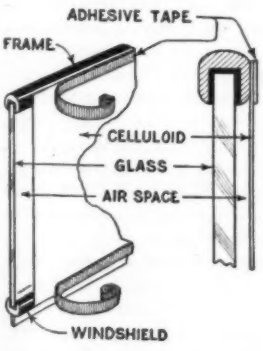


onto the piston head. If the compression then becomes all right, the trouble is in the fit of the piston and rings. If the oil makes no difference in the compression, the fault is in the valves and they should be ground in.

The next job is to make sure that gasoline is flowing freely to the caburetor. The reason for this is that choking an engine for cold weather pulls up a lot of gasoline suddenly and a partially clogged screen will hamper the flow. Such a condition will prevent getting a mixture that is rich enough for starting. Start at the gasoline tank and, if a screen is there, clean it out. If a strainer is in the line, it should be opened and cleaned. Using compressed air on the line, blow out any foreign matter. The screen at the top of the vacuum tank should be cleaned as well as the screen in the carburetor.

To prevent sucking in air when trying to start the engine, see that the carburetor and intake-manifold gaskets are tight. For best operation in cold weather the carburetor should be set a little richer than for summer running according to your car's instruction book. If carburetor heat is adjustable, the lever should be set to "Hot," "winter position," or however it may be designated.

Having uniform compression and a good supply of fuel, the next requirement for easy starting is to have a good spark. For this, first see that all wiring connections are clean and tight. At the coil, be sure that everything is clean. Dust and dirt on the outside of a coil will let the high-tension current leak away instead of going to the plugs. Remove the distributor cap and take off the arm. This will expose the breaker points. See that the moving contact is perfectly free and makes contact with a snap. A drop of very light oil on the pivot pin will help this action. With a fine oilstone or contact-point file, smooth up the points so that their surfaces are clean and square with each other. If they show a uniform frosty surface, it will be unnecessary to touch them.



If definite instructions are not available on your car, a good average adjustment for breaker points of battery systems is to set them so they are separated by .022 in. when fully open. Inexpensive gauges for measuring this can be bought at most automobile-supply shops and at many ten-cent stores. If your car has double sets of breaker points, they should be synchronized according to the directions in the instruction book.

With a toothpick place just the lightest touch of vaseline on the breaker cam. Wipe off the distributor arm, place three drops of oil in the felt in the top of the distributor shaft (if there is such a felt in your car), and wipe out the inside of the cap. If the arm has a brush that touches the cap, place just a touch of vaseline on the brush. Replace the cap carefully and clip it down.

See that all ignition wires are in good

condition. Heat, oil, vibration and moisture work to spoil insulation, and if the wires are chafed or show any cracks, they should be replaced. To avoid confusion in renewing wires, replace only one at a time. Be sure that each wire is well down in its socket in the distributor cap.

Spark plugs should be cleaned inside and out. Porcelains should not be scratched or cleaned with sandpaper, but, a powder, such as Bon Ami, may be used for removing stubborn carbon deposits. In putting separable plugs together, be sure that the copper gaskets are in place and then pull the pack nut down snug but not as tight as you can; too tight a fit may break the porcelain. When adjusting the gap, never bend the center wire but bend the wire on the base of the plug shell. If you don't know the correct gap for your car, setting the points .025 in. apart will give good average results. The important thing to watch is that all gaps are set the same. When putting the plugs back, a little graphite on the threads will make removal easier the next time and help maintain a tight fit. Be sure that the copper gasket is in place between the plug and engine on all plugs except those used in the old model-T Ford. Wipe the outside of the porcelains clean, as oil will collect dust, dust will hold moisture and moisture will let the spark leak away over the outside of the plug.

Strange as it may seem, heavy summer engine oil may weaken your spark in winter. What happens is this: The oil gets very stiff in cold weather; when the starter button is pressed, so much current is required to turn the engine over that the voltage drops too low to supply enough current to the ignition coil to furnish a hot spark. Furthermore, heavy oil will not circulate as it should, and considerable wear may take place before the engine warms up sufficiently to get the oil to wearing parts. The answer is, consult your instruction book or the chart of lubrication recommendations at any filling station and use the correct grade of oil for your engine.

Before changing to winter oil, it is well to drop the engine pan and clean out the summer's accumulation of dust and dirt. The oil screen should be cleaned with gasoline and a brush. Don't wipe it with a cloth, as the lint will cause clogging at some future date. Never flush the engine with kerosene, as doing so loosens dirt, metallic particles and sludge that is doing no harm, and puts it in circulation. The ideal time to drain is after a long run when everything is thoroughly hot. Then the oil comes out with a rush and carries with it practically all foreign matter.

While a stiff engine will cause a weak spark, there are other things that will weaken the ignition. A weakened, or under-capacity, battery will make starting hard. The battery should be kept fully charged, that is, up to a hydrometer reading of 1.250 to 1.300 in every cell. A battery in this condition will not freeze, and will do its share toward making starting easy. The battery should be clean, tight in its carrier, and the terminals bright and tight. Terminals corrode but can be cleaned with a strong solution of washing soda or ammonia and water. They should then be dried, tightened and smeared with vaseline.

To keep the battery charged may require a higher charging rate than is used in summer. Practically all cars now have what is called a third-brush regulated generator. To get a higher charging rate with such generators, move the third brush (which is about half as thick as the other brushes) in the direction that the generator runs. The holder for the third brush is generally attached with a screw or nut that can be seen by looking carefully. If your generator has been charging 8 or 10 amp. maximum all summer, setting it up to 12 or 14 amp. will probably take care of winter requirements.

Cold weather annually does much damage to the transmission and rear axle. Normally the lubricant in these units is fairly heavy, and, when the thermometer drops, it becomes almost solid. It does not circulate until friction has warmed it up, and then the damage is done.

With the coming of cold weather it is well to drain the transmission and rear axle, wash them out with kerosene, and fill with winter-grade lubricant. If the lubricant has been recently put in, or is known to be in good condition, it will be all right to use it, but to make it flow, light oil must be added to it. To do this, draw off 1 pt. of the lubricant from the rear

axle and substitute 1 pt. of light engine oil. In the transmission, because of the lesser capacity, ½ pt. is usually sufficient. There are on the market certain so-called penetrating oils, especially recommended for making heavy lubricants more fluid. How to use them is always explained on each container.

While on this subject, it is well to mention that the entire chassis should be lubricated with grease or oils that are lighter than those used in warm weather. This is particularly true of the steering gear if wear and hard steering are to be avoided. Wheel bearings should be cleaned out and the lightest cup grease applied.

With the running of the car assured, the next thing of importance is comfort in the car. The matter of fitting a heater is a story in itself. However, any heater will do better if the car is well insulated and ventilated. Where construction permits, it is well to fit felt strips around the doors of closed cars. Under the mats on the floors insulating felt or even newspaper should be laid. "Pants" should be fitted to pedals or gear-shift and brake levers to keep out drafts. A piece of inner tube, tacked to the floor and tied around the levers or pedals, makes a good substitute. Corks should be cut and fitted in all holes in the dash. A radiator shutter is helpful not only for quick warming up of the engine, but for keeping the cold air off the dash and hence keeping the car warmer. Lining the hood with asbestos is another way of retaining engine heat.

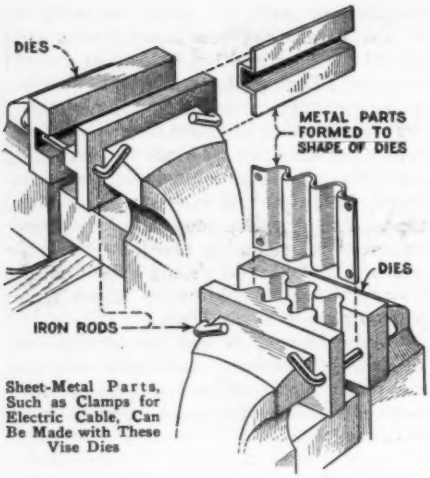
In very severe climates, storm windows for closed cars can be made by stretching celluloid over the windshield and windows, holding it in place with medical tape. The air space keeps the car warmer and prevents steaming and frosting of the glass. The celluloid should extend all the way to the glass channel to assure about ⅛ in. or more of air space.

Where heaters depend on forcing outside air into the car, their efficiency can be greatly increased by fitting an exhausting ventilator at the top of one or more windows.

Pair of Scissors Used as Dividers

When a pair of dividers are not at hand and it is necessary to scribe a circle or arc, substitute a common pair of scissors. Tie a lead pencil to the top of one of the thumb or finger holes, letting the pencil rest over the other hole where it can be firmly held against the handle with the thumb and fingers. In this way the points of the scissors are securely and rigidly held apart the desired distance without clumsiness or inconvenience.—August Jeffers, Indianapolis, Ind.

CAPACITY OF SYSTEM IN QUARTS	10 DEGREES ABOVE			ZERO			10 DEGREES BELOW			20 DEGREES BELOW			30 DEGREES BELOW		
	NUMBER OF PINTS OF ANTI FREEZE REQUIRED TO PROTECT AGAINST FREEZING AT ABOVE TEMPERATURES														
	ALCOHOL	GLYCERINE	E.GLYCOL (PRESTONE)	ALCOHOL	GLYCERINE	E.GLYCOL	ALCOHOL	GLYCERINE	E.GLYCOL	ALCOHOL	GLYCERINE	E.GLYCOL	ALCOHOL	GLYCERINE	E.GLYCOL
8	5	8	4	6	11	5	8	12	6	9	13	7	10	14	8
10	6	10	5	8	14	7	10	15	8	11	16	9	12	18	10
12	7	12	6	9	16	8	11	18	9	13	19	11	15	22	12
14	8	14	7	11	19	9	13	20	11	15	22	13	17	25	14
16	10	16	8	12	22	10	15	24	13	17	26	15	20	29	16
18	11	18	9	14	24	12	17	27	14	19	29	16	22	32	18
20	12	20	10	15	27	13	19	30	16	21	32	18	24	36	20
22	13	22	11	17	29	14	21	33	17	23	35	20	27	40	22
24	14	24	12	18	32	15	22	36	19	25	38	22	29	43	24
SPECIFIC GRAVITY	0.970	1.08	1.04	0.96	1.108	1.05	0.95	1.12	1.06	0.94	1.13	1.065	0.92	1.144	1.07



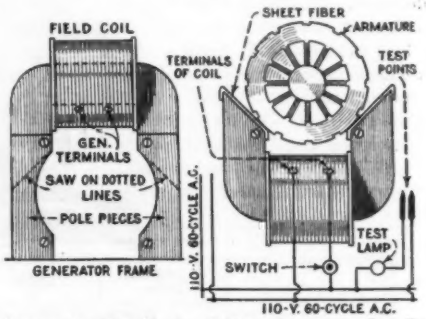
Sheet-Metal Parts, Such as Clamps for Electric Cable, Can Be Made with These Vise Dies

Sheet-Metal Parts Made with Vise Dies

Sheet-metal holders for electric cable were bent to shape with the aid of vise dies as shown in the drawing. The dies are held in alinement by means of small rods passed through a hole in each die and having the end bent over at right angles. While only two examples are shown, it is obvious that any shape of die can be used, and a large quantity of parts can be made in a short time.—George A. Luers, Washington, D. C.

Growler for Testing Armatures

It is rather difficult to tell whether or not an armature is in good condition without using some kind of testing device. A "growler" with a test lamp will plainly show if the armature is free from grounds, short circuits and open coils. An efficient growler can be made at a very small cost by obtaining an old "autolite" generator, model GA, type DR6, used on old Willys-Knight cars. It consists of a laminated core of horseshoe shape, and has one coil winding above the armature. The magnet and coil are not inclosed in the generator housing. With a hacksaw, saw off the bottom of the magnet, as indicated by the dotted lines in the drawing. Mount the coil and magnet on a wooden board with the coil downward and a snap switch and test lamp below it, connecting them as shown. Place thin strips of aluminum or fiber over the ends of the magnet to insulate them when the armature is placed between the ends. With the switch off, put the armature in the fork of the magnet; then turn on the switch. Hold a hacksaw blade on the top of the armature, lengthwise and almost touching. Revolve the armature slowly by hand. If the blade is attracted by the magnet, it indicates a short circuit in the coils. Connect a 6-volt lamp in series with two test points. Place the points on different segments of the commutator. Vary this position by shifting from one to another segment with the test points. Some position will cause the lamp to light. Keep this position and revolve the armature; if the lamp fails to light on any two segments, it indicates that the coil connected to these segments is open. The trouble can also be located by short-circuiting two segments; when the connection is broken, a spark occurs if the coil is in good condition, but, if not, the coil is open. The growler must be used on 110-volt a.c. because of its fluctuating effect in the magnetic field. An armature may be free from faults when standing still, but grounded when running. This is due to the coils being loose in the slots, and the centrifugal force, while revolving, throws the coils against the slots in the armature. When an armature is cool, it may appear to be in good condition, but after it heats up, it may be grounded owing to expansion of the wire or softening of the insulation. This can be decided by heating the armature before testing. The test lamp may be used in testing for grounds by holding one test point on the armature shaft, and



Inexpensive Growler for Testing Armatures Can Be Made from Old Auto Generator

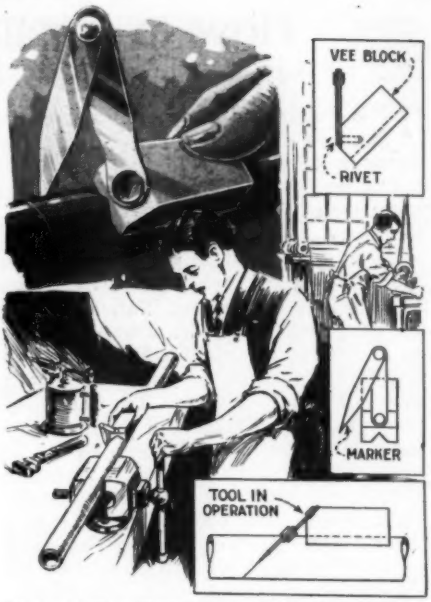
if the lamp lights while touching any one of the segments of the commutator, that coil is grounded.—C. F. Brown, Charleston, S. C.

Rubber Heel Saves Tools

One way of saving the edge of your tools when used to cut down stakes, etc., is to tack an old rubber heel to the bench top near one end. It will be found resilient enough to absorb the thrust and prevent the point of the work from being injured, and it will also save the sharp edge of the tool by preventing it from striking a hard surface after each cut has been made.—Hal Kramer, Allston, Mass.

Floodlight for the Amateur Photographer

Any amateur photographer requiring artificial lighting will find the floodlight shown in the photo easy to build, while the entire cost will not exceed $10. It consists of a reflector made of nickeled zinc bent to the shape of a small waste basket, with the small end 8 in. square, the opening 13 in. square, and the sides 12 in. deep. The bottom is backed with a piece of wood, 1 in. thick, in order to provide additional support for the socket and lamp. A mogul socket should be used, securely fastened to the bottom by means of a crowfoot bracket and a short piece of pipe. Flexible cord and a snap switch are installed, which completes the device. A 1,000-watt lamp is used. This type of light surpasses a flashlight for interior photos because the latter is practically instantaneous and gives too deep shadow and too strong high light, while, with this floodlight, the photographer can make a longer exposure, moving the light from side to side on a line with the camera, in order to eliminate deep shadows.—Dale R. Van Horn, Walton, Nebr.



Block with Two Pivoted Arms Marks Pipes at 45-Degree Angle

Pipe-Marking Tool

Many right-angle tube and pipe joints are made by welding, which necessitates a 45° cut on the pipes. A small shop owner devised a marking tool, which insured accuracy when cutting off the lengths of pipe at this angle. The tool consists of a V-shaped block with one end cut to a 45° angle. To this end a sheet-metal arm is pivoted, and to the other end of the arm and made of the same stock, a marker is similarly pivoted. In use, the pipe is chalked at the approximate spot where it is to be cut and the V-block is held against it as shown in the upper detail. Then, without moving the V-block, the marker is swung around, being pressed against the pipe to scribe a line on it. As there are two joints which permit both parts of the marker to move, it is possible to make the marker follow the contour of any pipe within its capacity. An accurately marked pipe can be sawed off correctly to make a joint that will require very little building up with the torch.

A block of 1½ by 3 by 5-in. soft rubber is useful as a pad for sandpaper in smoothing curved surfaces.

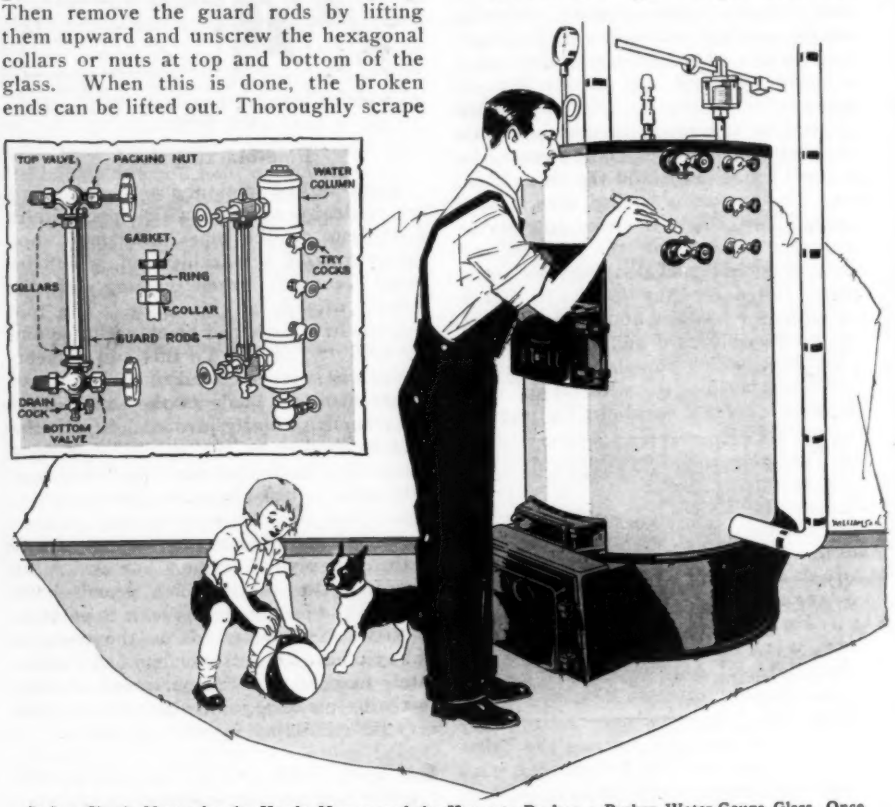
How to Install a Gauge Glass

By C. J. GEISER

THE installation of a new water-gauge glass on a steam or hot-water boiler seems a difficult job to the uninitiated handy man around the house, whereas, as a matter of fact, it is a very simple undertaking.

Water gauges on house-heating boilers are of two types, the simple gauge shown at the left in the detailed illustration, and the gauge combined with a water column as shown at the right. When a glass breaks, however, the procedure is exactly the same with both types. The horizontal valves at top and bottom of the glass permit communication with the boiler to be shut off, so the first thing to do when the glass breaks is to close both valves tightly. Then remove the guard rods by lifting them upward and unscrew the hexagonal collars or nuts at top and bottom of the glass. When this is done, the broken ends can be lifted out. Thoroughly scrape and clean all old rubber out of the collars, from the brass rings that were between the collars and the ends of the tube, and from the sockets into which the glass fits.

If a new glass is not at hand, and the boiler is in use, the height of the water in the boiler is determined in the meantime by means of the try cocks shown. If the boiler has a water column, the try cocks are fitted on it; if not, they are fitted to the boiler near the gauge glass. In either event their purpose is the same. Water should issue from the lower cock when it is opened, and the center cock may also show water when it is opened. The water in the boiler, however, should not be allowed to get so high that it shows



It Is a Simple Matter for the Handy Man around the House to Replace a Broken Water-Gauge Glass, Once He Knows How to Go About the Job

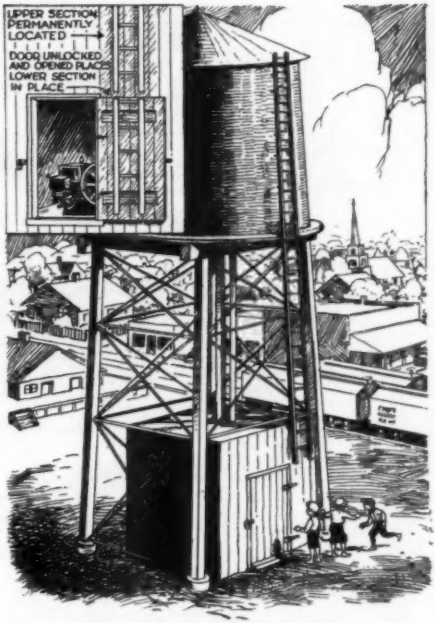
from the top cock. Some boilers have but two cocks. In this case the bottom cock only should show water.

The new glass should be cut about 5/8 in. longer than the distance from the opening in the top valve to the opening in the bottom one. Slip a collar, a ring and a new gasket on each end of the glass, as shown in the detail, and slip the lower end of the glass in the lower valve socket, pushing it down all the way so that the upper end can be brought into place. Now equalize the length extending into the sockets at each end and tighten down the lower collar with the fingers. See that the glass does not slip down as you do so, for if enough of the glass does not enter the socket at either end, you will not be able to make the joint tight. Keep the glass firmly in position, therefore, until the collars at both ends are tightened with the fingers; then the tightening may be completed with the wrench. Do not tighten down too hard, or you will break the glass.

If you have no new gaskets, a substitute may be made from asbestos thread, graphited, or even from twine well soaped or oiled. Use seven or eight strands, rolled into a rope about 9 or 10 in. long. Wrap this around the glass firmly, wrapping in the same direction as the collar moves when tightening, so that the packing will not buckle when the collar is screwed down. Push the rolled packing down evenly inside the collar with a blunt tool of some sort, then replace the glass as above. Replace the guard rods, open the top and bottom valves, and the job is done.

The glands under the packing nuts on the top and bottom valves need occasional repacking, and this is also a simple job. Unscrew the nuts, dig out all the old hard packing, and use graphited asbestos thread or soaped twine as for the glass, but only about one-third the quantity specified. Be sure to wrap the packing about the valve spindle in the same direction as the nut moves when tightened. Do not force in too much packing, or difficulty will be experienced in getting the nut started on the gland.

¶In lacing belts, never cross the laces on the side which is to be placed against the pulley as they will be cut quickly.



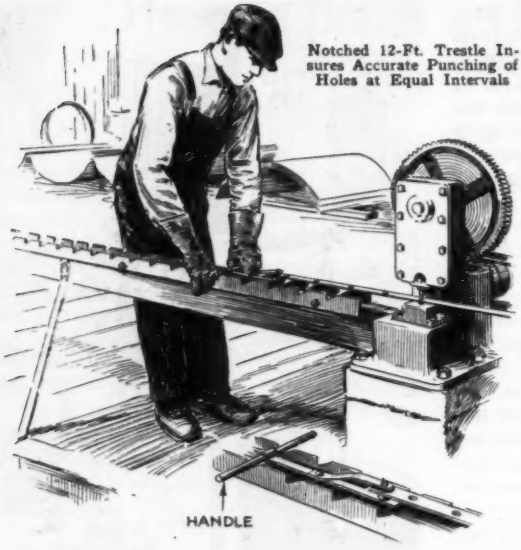
Making a Water-Tower Ladder Inaccessible to Boys by Attaching Lower Section to the Pump-House Door

Water-Tower Ladder Made Inaccessible to Boys

In a Wisconsin village, it became a popular sport with small boys to climb to dangerous heights on the municipal water tower, by means of the outside ladder. To end this practice the ladder was moved close to the pump-house door and part of its lower end cut off and attached to the inside so that, when the door was closed, the ladder was entirely out of reach. To use it, the door was opened against the side of the pump house so that the workmen could ascend without trouble.

Substitute for Collar Button

In an emergency I found the use of a common brass paper fastener, which consists of a head and two flat legs and somewhat resembles a cotter pin, an excellent substitute for a collar button. It is passed through the shirt and collar holes from the inside, after which the legs are bent over flat. Such a fastener will also serve as an emergency cuff button.—Walter W. Uhlman, Lackawanna, N. Y.



Notched 12-Ft. Trestle Insures Accurate Punching of Holes at Equal Intervals

Spacing Fixture for the Punch Press

In a factory where a job required the punching of holes at equal intervals in 12-ft. lengths of sheet metal, the fixture illustrated was used to advantage. It consists of a 12-ft. wooden trestle with a notched spacing bar of steel bolted to each side. A special handle to pull the work through the press is shown in the detail. It is made of a 12-in. length of light, flat metal, with a suitable rod welded to one end and a pin on the upper surface at the opposite end to engage the first hole in the work. A flat spring is welded to the upper surface of the tool so that it rests on the tip of the pin to prevent the latter from slipping out as the work is pulled along. Several sets of notched bars are prepared and kept on hand to suit other jobs that require different spacings.—Jos. C. Coyle, Denver, Colo.

Golf-Ball Substitute for Practice

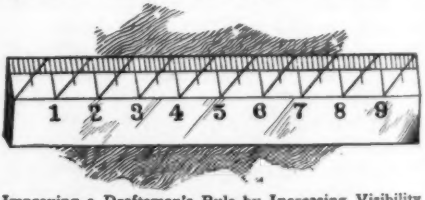
Round paper milk-bottle caps make excellent golf-ball substitutes for indoor or outdoor use in practice to improve your drive, brassie or midiron shots. Press the cover edgewise into the earth or a crack in the floor, or even between grass blades on the lawn. If you chop it, it won't go far but if you hit it squarely on the edge it will go a considerable distance.—Harry F. Hess, Des Moines, Iowa.

Cord Attachment Helps Start Tractor

Tractors of the McCormick-Deering type, which have manually operated impulse starters on the magnetos, can be made to start much easier by the addition of a simple cord attachment, especially when the magneto is located under the hood, which must be lifted every time the starter is tripped to start the motor. The impulse latch is designed with a groove around the trip pin. By cutting a small slit in the end of a piece of rawhide cord, it can be slipped over the pin and seated in the groove. The other end of the rawhide is then run out through a louvre in the hood. A single pull will trip the latch, and the rawhide is not heavy enough to keep it from returning to the running position. One farmer uses a bent piece of wire to do this, keeping the wire hanging on one of the hood fasteners.—A. C. Wilson, Columbia Cross Roads, Pa.

Improving Marking of Draftsman's Rule

Draftsmen's rules are usually graduated very finely so that it is difficult to find the inch marks at a glance. By making diagonal lines, running from one inch to the next, as shown in the illustration, this trouble is entirely overcome. The marks



Improving a Draftsman's Rule by Increasing Visibility of Inch Marks on It

can be made with a sharp knife and are later filled with ink.

Glass should be fitted loosely in a picture frame to provide for expansion.

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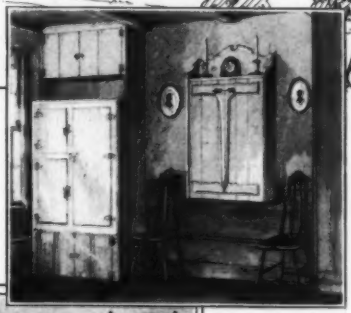
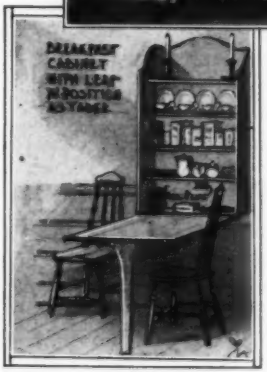
PLAN 5-D-18

A House That Pays For Itself





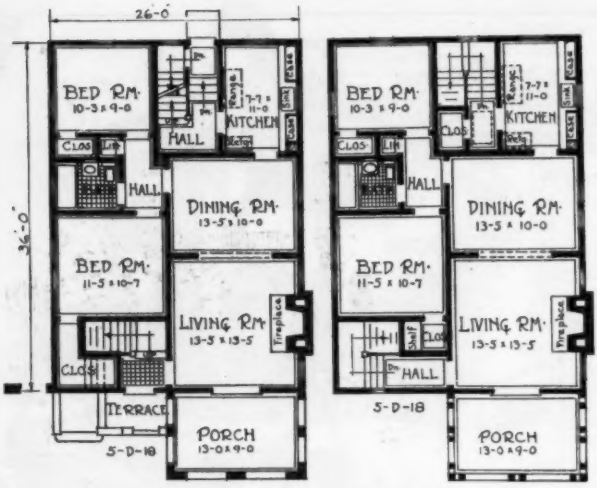
IN THESE days when profits and income are uppermost in the mind of most people, homes that pay for themselves out of rent money earned are increasingly popular. They bring money once a month into the family pocketbook and that's important. Furthermore, rent money obtained from an upstairs tenant, provided you live below, can be applied against building costs. Under normal conditions, this rent money should pay financing charges and also a fair profit over a period of about twenty years. It will pay off in much less time if you rent both apartments.

There are many arguments in favor of two-family dwellings. Often, at little more initial outlay of money, relatively speaking, than it costs to build an ordinary bungalow, you can extend the side walls upward, duplicate the floor plan, install a second heater, add another bathroom, and you have two bungalows, one on top of the other, or a two-family house. All of which may not be achieved so easily as it sounds, but is worth while considering if you are practically minded and want to make dollars spent for home building produce something more than paper profits.

The old-style double house required a wide lot, a big cellar and wide roof. Present-day duplexes which put one bungalow on top of another reduce the cost of cellar and roof. You can build them, therefore, on narrower and less expensive land.

Here is a new design for a duplex or

Popular Mechanics Magazine will supply readers a one-sheet blueprint of any house appearing in the magazine for $1.



FIRST FLOOR PLAN SECOND FLOOR PLAN

two-family dwelling in Italian style. It offers everything normal folks require whose tastes are not extravagant. The plan is excellent, the equipment modern, the style popular, the resale value high and the cost to build reasonable. According to the designer, $10,000 should build this duplex in or near large cities. In smaller communities, the cost will be somewhat less.

Suppose you pay $3,500 for a building site. You would be justified in spending that much money. Experts say a ratio of three to one is about right; three for the house and one for the site. Which means you should be able to purchase an excellent building site for this duplex; a much better one than if you were building a single-family bungalow costing around $5,000. Because of the higher price you are justified in paying for a duplex site, you almost instantly increase your chances for quick appreciation of both house and site. Don't forget that renters demand good location. That's important in your pay-off program.

Let's say the total cost of duplex and site runs around $13,500. Roughly speaking, you make an investment which should bring at least $50 per month rent from a tenant, perhaps more. That amount of rent money over a period of from eighteen to twenty years should come pretty close to paying off your financing charges. If you rent both apartments, you can amortize your charges in one-half the time and also take a reasonable profit.

But don't forget to select an excellent site and build your duplex of sound construction. That's important as a protection against rent depreciation. Investment in a neighborhood that is depreciating instead of increasing in value is always poor business, but doubly poor when you have property to be rented.

The Italian-style duplex illustrated offers five good rooms and bath on each floor—complete bungalow equipment. The porch may be glazed for living or sleeping purposes. This will add more year-round useful area. Note that the exterior shows only a single entrance. This is in line with present-day duplex design of making them appear like single-family dwellings.

This duplex is of frame construction with stucco exterior on metal lath. The roof is tile or may be asbestos shingle or wood. The house construction may be masonry, solid brick, brick veneer, or stucco on hollow tile. A rustic corner dresses up the exterior and supplies style.

To summarize: You have a compact two-family dwelling of fine plan in popular style at reasonable cost. If you want a free ride to home ownership, that is to say, a property that by rent money makes your own rent a small one or perhaps none at all, then it's worth while considering a two-family dwelling. This duplex is as fine a plan as you will find in a long search. Study it.

PLAN BOOK FOR READERS

A NEW BUNGALOW BOOK: Sixteen selected low-cost bungalows in popular styles, at prices ranging from $5,000 down to $2,000. Each house fully described and illustrated. Send ten cents in stamps to cover mailing.